Electrical World

The Consolidation of Electrical World and Engineer and American Electrician.

Vol. XLVII. NEW YORK, SATURDAY, JUNE 23, 1906. No. 25.

PUBLISHED WEEKLY BY THE

McGraw Publishing Company

114 Liberty Street, New York.

Telephone Call: 7605 Cortlandt. Cable Address: Electrical, New York.

Edited by T. C. Martin and W. D. Weaver.

Chicago Office.....1139 Monadnock Block
Philadelphia Office.....Real Estate Trust Building
Cleveland Office.....405 Cuyahoga Building
European Office.....Hastings House, Norfolk St., Strand, London, Eng.

TERMS OF SUBSCRIPTION

United States, Canada, Cuba and Mexico.....Per year, $3.00
Foreign Countries, within the Postal Union.....$6.00
Great Britain and Ireland.....25 shillings
Germany.....25 marks
France.....31 francs
Single copy.....10 cents

Remittances for foreign subscriptions may be made through our European office. Requests for changes of address should be made one week in advance, giving *old* as well as new address. No copies are kept on sale beyond fifteen months from date of issue, except in bound volumes.

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Entered as second-class matter at the post office at New York, N. Y., under the Act of Congress of March 3, 1879.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week.

Of this issue of the Electrical World *16,000 copies are printed. Total circulation for 1906 to date, 474,500, an average of 18,980 per week.*

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Engineering Ethics.

The presidential address of Dr. Schuyler Skaats Wheeler to the American Institute of Electrical Engineers, printed in full in our issue of June 9, is a timely reminder to the electrical engineering profession of the growth of its responsibilities and the dignity of the calling. Dr. Wheeler specifically draws attention to the need of creating an adequate code of ethics for the engineering profession, such as already exists in connection with the older and long recognized professions of divinity, law and medicine. Not only do we heartily support Dr. Wheeler's contentions, but we would also second them by the proposition that in the public mind it is the existence of an ethical code among the members which stamps and differentiates a profession from a craft. That is to say, when the members of any public service enter into a stage of development in their duties whereby they are bound by a recognized code of ethics, in their mutual relations on the one hand and in their relations toward the public on the other, the vocation is promoted in public estimation to the rank of a profession. If this proposition be valid, as we contend, then it follows that the recognition which the public is prepared to offer to the engineering profession depends upon the recognition which engineers offer to each other and to the dignity of their own labors. In the sociological system of mediæval Europe, the constructive powers of nations were entrusted to guilds. Each guild had its own officers, regulations and code of duties. Membership in the guild brought certain advantages and certain corresponding responsibilities. The engineers destroyed these guilds by creating machines and distributing the mechanical power that displaced muscular aptitude and ability. It remains now for the engineers to take the guild spirit from the body which their labors destroyed.

There is perhaps no class of highly trained public servants so devoid of training in co-operative effort as physicians. Their work tends to keep them segregated and apart, so that their opportunities for team play are necessarily limited. Nevertheless, there is no vocation in which professional ethics is more highly developed, or its dictates more scrupulously regarded. If, therefore, professional ethics can be highly developed among the members of a profession which keeps them independent and loosely connected, how readily should such ethics be developed among members of a profession like engineering, which requires so much intercommunication between its workers, and such close co-operation in many directions. Mr. Carnegie, who is manifestly actuated with the spirit of co-operative purposes and achievement, has either consciously or unconsciously had the development of engineering professional ethics in view, when he offered the engineering societies a handsome gift on condition that they assemble in a united headquarters in New York City. It would be fitting if the several societies which will inhabit the building were to recognize fully the principle of co-operation by the appointment at an early day of a joint committee to formulate a code of professional ethics for the engineering professions, to be submitted to all of the various engineering bodies for mature consideration in advance of any final action. And we would suggest that one of its sections might well define the length to which electioneering for engineering society offices may properly be carried on.

Speed-Voltage Variation in Shunt Motors.

As is well known, the armature of a direct-current motor runs at a speed such as to generate by the motion of its conductors across the field flux an e.m.f. less than the impressed e.m.f. by an amount sufficient to allow to flow through the resistance of the armature a current whose product with the field flux produces the torque demanded by the load. If, therefore, the resistance of the armature of a shunt-wound, constant-voltage motor is small, a very slight change in the counter voltage will produce a large variation in the armature current, and the machine will operate at practically constant speed at all loads. If the field flux of this same machine varies directly with the exciting magnetomotive force, then a change in the impressed armature e.m.f. will produce a similar change in the field flux, and the speed will remain constant even when the voltage is varied. Thus, such an ideal motor would operate at constant speed under all conditions of service. It is impossible to construct an armature without appreciable resistance, and the field flux of a commercial machine does not vary directly with the exciting magnetomotive force, so that the assumed ideal condition cannot be realized in practice. On page 1298 of this issue, Dr. A. E. Kennelly describes an interesting method by which the variation in speed with change in voltage of a shunt motor may be determined graphically when the armature resistance and the saturation curve or "saturation factor," are known. The treatment has been rendered extremely simple by assuming a constant IR drop in the armature and a certain determinable percentage change in field flux for each per cent of variation in exciting current.

Grounds for Secondary Circuits.

The paper and discussion on grounding secondary circuits at the recent National Electric Light Convention reveals the importance of immediately investigating further the question of procuring cheap and satisfactory grounds in soil which sometimes is lacking in permanent moisture. The paper on this subject by Mr. Sidney Hosmer, giving the experience at Boston, together with the subsequent discussion, which gave some sidelights on the Boston situation, showed that the method of grounding recommended in the National Electrical Code, namely, that of burying a copper plate in coke, is one which gives grounds which are far from having a low resistance in many cases. A poor ground for secondary circuits may be a little better than no ground at all, but it does not by any means afford complete protection. The Boston experience was corroborated by testimony from New York confirming the unsatisfactory character of such grounds. The solution adopted at Boston was to ground the secondaries at each customer's premises on the water pipes, while in New York it was found to be cheaper to run continuous secondary ground wires over the whole alternating-current district back to the power station, where a good water pipe ground could be obtained. In a very scattered distribution the cost of running such a continuous ground wire would probably be greater than that of grounding at each customer's premises. It is likely, however, that it will be found that this continuous ground wire plan has a much wider application than would be at first supposed. In small towns the expense of making a good ground on each customer's premises may cause the managers to hesitate to take this decidedly desirable step. It is important, therefore, that the method of grounding should be cheap as well as effective. Of course, nothing, however cheap, is to be considered unless it is effective, as a poor ground is like an investment in a bogus insurance policy. A collection of data on the resistance of various types of grounds in various soils would be of great value at this juncture, when many companies are in the midst of the work of grounding their secondaries.

Electrical Apparatus in Solar Eclipse Observations.

The Royal Society of Great Britain has recently published six reports on observations of the total solar eclipse of August 30, 1905. The observations were made in Spain, in northern Africa and in Egypt. One of the expeditions to Spain settled at Castellon de la Plana. Unfortunately, the sky became cloudy during the day of the eclipse, and so all observations were practically null and void. A peculiar form of thermopile was, however, set up for use, which may serve on some future more favored occasion. It consisted of a ring of ten bismuth copper junctions mounted on a mica disk and set in the eyepiece of the reflective telescope. A potentiometer method was used for measuring the e.m.f. developed in the ring thermopile when set into adjustment. The dimensions of the pile were such that at totality, the image of the coronal ring would fall upon all the ten heated junctions in the annulus. In full sunshine at Castellon the observed solar radiation intensity was about 1 calorie per square centimetre per minute; or each square centimetre of the earth's surface received nearly one megerg per second after the radiation had passed through the earth's atmosphere. Observations on the moon gave a radiation intensity of 150,000 times less than the sun, or about 5 ergs per square centimeter per second. The apparatus had a sensitiveness sufficient, it would seem, to detect some slight radiation from the planet Jupiter.

Explosion of Glass Tubes Containing Radium Salts.

The *Physikalische Zeitschrift*, of June 1, contains an interesting and important article by Prof. Paul L. Mercanton upon a research with a glass tube containing 15 milligrammes of radium bromide. The observation has been made, both by Mme. Curie and by Herr Precht, that a small glass tube containing radium salts, after having been sealed and set aside for many months, broke into shivers, without apparent cause. It is known that radium salts, contained in ordinary open air tubes, give off a gaseous emanation containing helium. The inference made from the explosion of the sealed tubes was, therefore, that the radium salts had kept steadily at work, week after week, generating gas, until finally the internal gaseous pressure burst the tube, scattering the valuable contents in all directions along with the debris of the walls. The estimated pressure required for this result had been in fact computed, and given in one instance as 20 atmospheres. In order, therefore, to preserve glass-enclosed radium salts, the most expensive substance the world has yet produced, it seemed desirable to unseal the tubes occasionally and give them a chance to blow and get rid of their enclosed products of manufacture. Arrangements were made on an elaborate scale to unseal a little glass radium tube which had been sealed for more than three years, containing 15 millogrammes of the purest radium bromide. An explosion chamber of thick glass was prepared, into which the tube could be made to burst at the proper time. In this explosion chamber the little radium tube was supported, with a few turns of platinum wire on its end, in such a manner that an electric current could be sent through the wire, the radium tube wall could be softened in its vicinity, the internal pressure could swell out the softened glass and allow it to burst into the explosion chamber. This chamber could then be connected with a quicksilver manometer, to measure the pressure

of the escaped gases, and also with a Geisler tube apparatus for spectrometer tests as to the nature of the gases.

An experiment was made with the apparatus, employing a little glass tube containing air at ordinary pressure, in place of the precious radium tube. The explosion chamber was exhausted by a mercury air pump, and sealed off. The current was then passed through the platinum wire. The heated wire softened the end of the little glass air tube under test. The internal air pressure expanded and opened the wall of the air tube at the softened point. The manometer forthwith measured the pressure of the released gas. In short, the dress rehearsal went off in splendid style. On the appointed day, February 16, the real and precious little radium tube with its 15 milligrammes of purest radium bromide was inserted in the explosion chamber with appropriate ceremonies, and the apparatus closed air tight. Slowly and with great care, lest a premature explosion should occur, the air pump was allowed to exhaust the explosion chamber. This was at last sealed off safely. The electric current was then turned on the little platinum heating coil and the effects looked for with bated breath. The wall of the radium tube heated up and softened, but, instead of expanding outwards, with the pressure of internal gases, it refused to budge. In fact, it seemed more inclined to collapse. At this juncture the platinum heating wire unfortunately fused and brought the experiment to an untimely end, without any explosion to reward the patient investigator for all his precautions. The barometer showed no pressure of any consequence, and the spectrometer showed no helium. Although it was not possible to observe any hole in the wall of the radium tube after disassembling the apparatus, yet from the radioactivity set up outside, it was inferred that the wall had actually been penetrated by the melting process. The experiment seems to show that gases do not accumulate within glass-sealed radium tubes, and also that there are more ways in Nature of shattering glass tubes than letting them fall or exploding them. Just why and how radium tubes do break into shivers is now an open question, and a most interesting one. It looks as though radium were not content with being itself unstable, but was bent on making its neighbors also unstable.

POWER IN THE FAR NORTH.

Nothing can give a more forcible illustration of the generally accepted and unsensational character of high-voltage plants than the article this week by Mr. V. A. Moody on the great system designed to supply Winnipeg with light and power. Three or four years ago a transmission line of 65 miles at a nominal voltage of 60,000 would have been widely heralded, and the unusual voltage would have caused world-wide comment. To-day as one reads the article he is impressed only with the remarkable elaboration of the switchboard appliances to which the generators and lines appear to be merely adventitious. Yet with such a plant in full operation we have a pretty well defined opinion that the transmission line will be the most serious subject of attention, as it always has been in the past in spite of the fact that high voltage is commonplace. With respect to the line, the town construction has been unhesitatingly followed, we hope not too hastily, but with several modifications which are interesting. Each tower is thoroughly grounded and is converted into a true lightning rod by a steel rod carried well above the line. How effective this will be remains to be seen, but it looks like a step in the right direction. It is not certain that a tower so protected could be struck without breaking down the line insulation, though surely the lightning rod is better than allowing the line to serve in this capacity quite unaided, and it probably will serve a useful purpose in a good many cases. A further point of interest in the line is the use of the very flexible hemp-cored cables, which should add to the security of a long span line in a somewhat formidable climate.

We shall watch with interest the performance of this line, which is certainly the "farthest north" for anything like similar voltage. As is well known to many of our readers, there are numerous lines nominally working at 60,000 volts which really have never been pushed to this pressure save in an experimental way. In fact, one notable example of tower construction rated at 60,000 has had a hard time in holding up its insulation at 45,000 volts. The transformers on the Winnipeg system have very wisely been provided with taps for 40,000, 50,000 and 60,000 volts, so that the working pressure can be made to keep pace with improvements in the art of insulation, about which there is still considerable to be learned at these very high voltages. We believe that there are no better high-tension insulators than those turned out by American makers. At 60,000 volts and upwards not only is the ordinary pressure high, but there is a chance of surging and resonance forcing the instantaneous pressure up to more than 150,000 volts, and we do not believe that a factor of safety of 2 for the insulators is sufficient unless under exceptionally favorable conditions. Fortunately, save for mechanical strains due to storms and temperature changes, the Manitoba climate is no worse than many another.

With respect to the utilization of this power we note with interest that it was decided to work the line at 60 cycles and to use motor-generators rather than to depress the frequency below the point advisable for lighting for the sake of using synchronous converters. Unquestionably the change is highly advantageous in the matter of working the line on account of the controlling power given by the synchronous motors. This again appears to have been secured at a very trivial loss in efficiency, the combined efficiency of a motor-generator set at full load being 93 per cent. These sets are also arranged to run as motors on the direct-current side, enabling the synchronous motors to be worked as generators if occasion requires. In the switchboard and cable equipment very thorough precautions seem to have been taken against breakdowns. Especially the leads in the station, often sources of serious trouble, have been given thorough protection. It is a striking tribute to the present quality of electrical apparatus that one instinctively assumes that the generators will give no trouble and feels free to turn his attention mainly to the accessories. Even the high-voltage transformers have earned a reputation for trustworthiness, and if one looks over critically the causes of breakdowns in transmission stations they are usually found elsewhere than in the main items of equipment. On the hydraulic side the Winnipeg system presents no remarkable features save in the serious work required in the canal. The head is low for so large a plant, so that two double wheels had to be put in tandem to get the requisite generator speed. These wheels being practically at the forebay, the conditions for regulation are of the very best in spite of the rather low head. The whole installation appears to have been carried out in a thorough and workmanlike fashion, as is fitting for a plant which must be the main reliance of the chief city of the great Canadian Northwest. Its cost has been necessarily heavy, but it is working in a region where fuel is necessarily dear, and the relatively cheap energy which is can supply will be a boon to the manufacturer.

Extensive Lighting and Traction Consolidation in Pennsylvania.

An interesting and important consolidation is being carried out of the lighting and traction properties in Schuylkill County, Pa., at the heart of one of the richest anthracite regions of this country, with Pottsville as a center. Conditions for the economical production of electricity could hardly be more favorable; and the district is growing rapidly in wealth and population, with coal mining as a basic industry, bringing many large manufacturing developments in its train, such as in textile, cement, etc. No fewer than fifteen separate companies are gathered into the one group, to be known as the Eastern Pennsylvania Railways Company; and in addition to the electric lighting of the region, these embrace nearly 60 miles of electric railway to which will be added about 20 miles of new high-grade track. The companies are: Pottsville Union Traction Company, Pottsville & Reading Railroad Company, the Schuylkill Haven & Orwigsburg Street Railway Company, the Schuylkill Electric Railway Company, Edison Electric Illuminating Company, of Pottsville; Anthracite Electric Light & Power Company, of Pottsville; Frackville & Gilberton Light, Heat & Power Company, Tamaqua & Lansford Street Railway Company, the Tamaqua & Pottsville Electric Railway Company, Coal Castle Electric Railway Company, the Port Carbon & Middleport Electric Railway Company, Edison Electric Illuminating Company, of Tamaqua; Citizens' Gas Company, of Tamaqua; the Minersville Electric Light Company, Citizens' Gas Company, of Minersville; and the Minersville Fuel Gas Company.

The engineering and general management of the property will be assumed by J. G. White & Co. and $1,500,000 will probably be spent in the immediate future in making the contemplated electric railway and lighting connections, extensions and improvements. The power will ultimately be generated in two power stations, and it will be distributed through various sub-stations located with reference to the demands of service.

The financial syndicate has underwritten and sold $3,500,000 of first mortgage 5 per cent thirty-year gold bonds, $975,000 of 5 per cent cumulative convertible preferred stock, and $4,000,000 of common stock. Of these securities approximately one-half are taken and held by the original owners of the various properties, the balance being sold to investors, here and abroad, for completing the several purchases and providing the money for improving and extending the several properties. The financial syndicate is headed by W. A. Read & Co., of New York, and Forrest & Co., of Philadelphia, who have issued a circular based on the detailed reports of J. G. White & Co. and Mr. William Barclay Parsons, showing a very promising future for the enterprise. The gross for 1905 of $469,054 would leave a surplus of $22,081 after payment of fixed charges and the preferred dividend and this is rising yearly so that 1908 would indicate a gross of $955,236 with a net surplus of $162,196. The growth of business of the companies in this region, on the existing network of circuits and tracks has averaged not less than 12½ per cent yearly since 1904. The six power plants of 5,110 kw capacity will be replaced by two of 6,500 kw with marked saving.

Some Figures on Niagara Power.

Mr. H. W. Buck, the well-known electrical engineer at Niagara, contributes to the *Outlook* some interesting data on Niagara power. The total available water of the falls, says Mr. Buck, would represent about 3,500,000 hp. To generate 1 hp continuously for a year by a steam engine requires about 13 tons of coal. To generate, therefore, continuously, 3,500,000 hp by steam would require about 50,000,000 tons of coal per year.

To generate electric power by steam with the most modern steam plant costs not less than $50 a horse-power a year, allowing for fixed charges and operating expenses. Niagara power can be generated and sold in large quantities for $15 a horse-power a year, or for $35 a horse-power a year less than is possible from the use of coal and the steam engine.

From the above it will be seen that if all the hydraulic energy of the Falls were utilized for power purposes there would result to the country an annual saving of $35 a horse-power for 3,500,000 hp, or $122,500,000, and in addition there would be an annual saving in coal consumption of 50,000,000 tons.

These figures illustrate what it costs the people of this continent annually to maintain Niagara Falls as a spectacle. They represent the saving to those who would consume the power, and not the profit of those who might own the power developments.

This waste involved in prohibiting the development of Niagara power might be likened to a great conflagration in which 50,000,000 tons of coal were annually consumed. Such a conflagration might be one of the most magnificent sights in the world, and people might come from all parts to view it, but the human race would certainly be justified in using every effort to stop the waste by putting out the fire. Moreover, it does not follow that even a very extensive use of the power will mar the beauty of the falls.

Electricity on Steam Railroads.

At the meeting of the American Railway Master Mechanics' Association, held this week at Atlantic City, the Committee on Electricity on Steam Railroads presented a report which is of particular interest from its discussion of gasoline and gasoline-electric motor cars. This report is reprinted below, with a few omissions relating to electric traction statistics:

The instructions to the committee were to consider and present to the association the relative advantages of the different systems of electric traction now in use as applied to interurban and suburban lines; also, as far as possible the relative cost of operating such lines by electricity and steam. The committee was also instructed to include in its investigations the different systems of gasoline, gasoline-electric and steam motor cars. The report states that this is almost the first recognition by the association of other motive power than the steam locomotive. Main line operation was not considered, branch lines, suburban and interurban lines which are feeders to main lines alone being discussed. The committee also understood that the question relates mainly to passenger traffic, as electric traction of freight is carried on to a limited extent only at the present time. Mail, baggage and express are being handled, but these are generally considered in connection with or a part of the passenger traffic.

The class of service considered breaks away from the steam railroad ideas of trains of cars drawn by locomotives, and takes up the individual car or cars, each provided with means of propulsion taking power from some central source. The main business of railroads is to sell transportation, and the only object in considering electric traction is to ascertain whether the cost of carrying passengers can be decreased or the amount of travel be so increased as to provide additional revenue to the road offering it.

In the year 1890, the census report gave for the United States the following mileages of street and suburban railways:

Electric	1,261.97	miles.
Animal	5,661.44	"
Cable	488.31	"
Steam	711.30	"
Total	8,123.02	"

In 1902 the mileage was:

Electric	21,907.59	per cent,	increase	1636.
Animal	259.10	"	decrease	95.4
Cable	240.69	"	"	50.7
Steam	169.61	"	"	76.2
Total	22,576.99	"	increase	177.9

Statistics are quoted to show that while since 1890 electric traction mileage has increased enormously, yet the greater proportion of the increase was at the expense of the other methods of traction. During this period there were some ephemeral experiments in the use of batteries and of stored compressed air for power purposes on cars, but none of these survive. The above figures also show the backward development in street service of the steam-driven car or "dummy," despite the vast advance in steam railroading proper during these years, and this in itself is almost a complete argument against the steam car or other types of self-propelled car, except for special situations.

In early electric street railway traction several attempts were

made to utilize an electric locomotive, but these were generally abandoned, although it is customary now on some roads to have trail cars attached to leading motor cars. The latest and most advanced practice is to have all cars equipped with motors controlled from the leading car. The development in electric cars has been marked not only by their increase in size and carrying capacity, but also in the size of motors employed. The earlier cars had 15 or 20-hp equipment, but it was soon found that these were inadequate to properly accelerate loaded cars, and now many heavy suburban cars are equipped with four 75-hp motors each, and in some cars the motor equipment totals 400 hp. There is thus available for comparison the steam railroad train, consisting of a locomotive with as many cars as the service demands, running at infrequent intervals, and covering perhaps 200 miles per day, as against the same road operated with individual electric cars, obtaining power from a general source, running at frequent intervals and fairly equivalent mileage.

It is perfectly apparent that the density of traffic is the ruling factor as to whether the steam or the electric road will prove the more profitable. It is quite well known on old-established lines what the passenger returns will be with fairly steady business conditions, provided there is no change in the train accommodations, but if there is an increase in train service it is almost sure to build up an induced traffic, the amount of which is difficult to estimate. Unless, therefore, there is a reasonable basis of expectation for such traffic, the steam railway that can fully care for its own is not in need of a new system, and the expediency is doubtful. On the contrary, there are many sections of country, well populated and suburban districts, where an increase of travel may be induced by improved facilities, the amount of which can be gauged by the density of population.

The travel which is contemplated is the local, short runs, which in many cases has been taken from steam railroads by competing electric lines, this proving that the more frequent service and general convenience of the trolley line is more attractive. Absence of smoke and cinders, open cars in season, connections with city lines, all add to the popularity of the trolley and give a business that can be profitably carried at lower rates, which, after all, is the main inducement. It is believed, therefore, that where there is a sufficient density of traffic it will pay steam railroads to handle their local suburban and interurban travel electrically, giving frequent trains and frequent stops, equaling the convenience and accessibility of trolley lines, for which the public does not have to stop to consult time tables, buy tickets and go to inconvenient points to get on trains. Traffic of this kind should have its separate tracks, as it would get in the way of fast through trains and itself would be impeded by slow freight trains, using the same tracks.

It would be possible to make a combination service in some territories, running slow freight though at certain hours when travel was light, or if the character of the freight would permit, to have special separate freight units which could keep out of the way of passenger traffic. As before stated, the particular class of service and the system to be used must be chosen with special reference to the situation, and these vary so that no general rule or information will apply. Few situations, however, will figure out profitably with the combination service, and if electrification is warranted for passenger traffic a complete change will be desirable, except possibly where there is through travel involved also.

By far the greater portion of present car equipments are for the use of direct current, but of late alternating current has entered the field and there are some very interesting single-phase operations, the motors employed being capable of running on either direct or alternating current, and by having suitable transformers on the cars, high line voltage may be carried, thus reducing the cost of distribution. Long-distance distribution is best accomplished by alternating current of high voltage, and if direct-current motor equipments are used the current is transformed at sub-stations at suitable intervals and generally not over ten miles apart. These stations are equipped with transformers for stepping down the voltage, and with rotary converters for changing the current to direct at suitable voltage for the line. Sub-stations on lines employing single-phase machinery have only the transformers, no rotaries being required, and this also reduces the cost of attendance.

The single-phase operation is economical on account of high voltage used on the line, and cheapens very much the cost of distribution from the sub-stations, there being no transformation between the power station and sub-stations. The car equipments however, are more expensive than direct-current apparatus, so that, assuming both to be of equal efficiency, the number of equipments and apparatus required must be considered, and their extra cost weighed as against the low cost of direct-current machinery and more expensive distribution to the line.

The present New York Central-New Haven Railroad situation is an interesting example of the application of these two systems of electric traction, and the ultimate working out of these two great problems will add greatly to the shaping and development of the future of electric traction.

The relative costs of operation with electricity and steam are difficult to state as there is very little accurate information of value. The results obtained by attempting to draw comparisons from hypothetical roads would depend entirely upon the assumptions which were made. For instance, a set of conditions could be assumed which would show a much lower cost of operation by electricity than by steam; another set could be assumed which would show practically equal cost, and a third set which would show that steam operation would be the most economical. In view of the fact that the assumptions would govern the results, it is believed that information of this nature would not be of value to the association and might lead to erroneous assumptions and misunderstanding. A number of electrifications are under way at the present time, employing various systems of distribution, and a considerable amount of data will no doubt be available in the near future.

Some time prior to the development of electric interurban railways the steam motor car or dummy, in many cases hauling a trailer, was used to a moderate extent, but at the present time few of these remain. In response to a demand from railroad managers for a motor car to operate on branch lines and special situations there has been recently a development of motor cars employing gasoline in an internal combustion engine, this engine either directly driving the car or driving a dynamo to generate current to be used for driving motors in the trucks. Some builders interpose batteries between generator and motors to store the energy when it is not all needed for propulsion, and to assist in starting on grades when the generator capacity may be insufficient. There is very great flexibility and convenience in this combination, but it is attained at very considerable expense and complication, and requires unusually skilled attendance not commonly available in railroad service.

The examples of the gasoline engine, electric generator, battery and motor types are the cars of the St. Joseph Valley Traction Company's line, built by F. M. Hicks, and the Strang car that lately made a successful run from New York to Kansas City. The gasoline engine on these types is set to run at a constant speed, and this characteristic is essential for the best economy of the internal combustion engine. The size of the engine used may be proportioned to the average power required for normal operation, and the speed variation and excess of power above normal requirements may be supplied by the battery equipment, which also comes into play for lighting and short movements and would also be available to bring the car in in case of a breakdown of the engine or generator.

The gasoline-electric type not employing batteries is illustrated by the D. & H. car recently built by the General Electric Company. The generator on this type of car has to be equal to the maximum requirements, and in order to vary the current for the conditions to be met, the field excitation is handled by a separate exciter, chain-driven from the main generator. The controller is semi-automatic and can be set for any predetermined maximum acceleration, and the speed of the car is governed by varying the field strength of the generator. The speed of the engine remains constant after acceleration. This application is very ingenious and effective, and the car has been put into regular service between Schenectady and Saratoga.

The Union Pacific motor car, representing the direct mechanical drive application of gasoline power, is driven by a six-cylinder reversible gasoline engine, with crank shaft at right

angles to the length of car; a sprocket mounted on same, driving a special chain, transmits the power direct to the driving axle through a second sprocket attached to the axle. The chain easily shows a transmission of power with an efficiency of 97 per cent, which clearly demonstrates that this method of transmission is very close to the maximum efficiency possible.

For the initial start of car, or putting it in motion, a reducing gear is used, and, until the car attains a speed of six or seven miles per hour the economy of this transmission is somewhat reduced; but, as the use of the gears is only temporary and lasts only a few seconds, it can almost be left out of consideration.

One of the most important features in the development of the steel motor car is the reduction in height of car and consequent reduction in weight and decreased wind resistance, a result of which is the system of ventilation—taking fresh air from the front of car, delivering it at floor level and by suction, drawing the foul air out of the roof.

The roof of the Union Pacific motor cars is 24 in. lower than the standard height of coach roof. The car being built of steel, with pointed end and smooth exterior surface, the wind resistance is materially reduced, enabling a 100-hp gasoline engine to drive the car at the rate of 65 to 70 miles an hour. The car framing is a combination of steel shapes and braces, the whole tied together by steel plates, making a unit structure, each part supporting the adjacent ones and bearing its proportion of the burden imposed upon it. These cars weigh, motor and all, 26 tons, which of course is a very material factor in the high speed attained by cars in service, and affords considerable economy in comparison with the heavier steam motor cars, some of which weigh 75 tons and over, with the same seating capacity. Motor car No. 7 has seating capacity for 75 people, and has, in actual service, carried 95. It is equipped with round metal sash windows —a window impervious to cold air, dust or water; in fact, is tight as a porthole on an ocean-going vessel. These windows have demonstrated themselves to be a great luxury to the traveler. The enclosed inside steps, with side door entrance, have also proved very popular with the traveling public. This side door entrance is permissible with steel car construction without weakening same, the side sill being depressed and divided, a portion being carried over the door and the other portion under, all being tied rigidly in combination with the plate and steel sheathing of the car; forming a structure of such strength as to eliminate the usual weakness caused by a side aperture the size of door opening in these cars. The first cars—55 ft. in length, seating capacity 75, and with an engine of 100 hp—are particularly adapted for branch line service, where the traffic is insufficient to support a steam service or anything like electric service.

Interest in the steam car is also being revived, as, for example, the Ganz cars imported from Budapest by the Florida East Coast Railways; also the Erie Railroad and the C. P. Railroad are experimenting with a steam car equipped with a Scotch marine type of boiler, using a superheater and oil fuel. It is believed that some one may undertake to make a so-called flash boiler that will be applicable to this service.

It is recognized that the so-called motor car, one carrying its own motive power plant, whether gasoline, gasoline-electric or steam, occupies a distinct field of usefulness. On many branch lines, now existing, where travel is light, and on new extensions into unsettled country where the business will not return a profit on steam train service, it would have to be run at a loss until a sufficient business was induced or built up by the travel facilities afforded. These situations are the distinct field of the motor car, which can be operated for less per car-mile than by regular steam train or electric methods until the volume of business will warrant the regular transportation methods.

The use of motor cars on the Union Pacific in picking up passengers on branch lines and in delivering passengers at connecting points for through trains, has been found to be exceedingly lucrative. The matter of giving the branch line patrons of any steam road increased service, with more frequent trips per diem, is very much appreciated by the local community, and their good will is beneficial.

On the hypothesis of the same density of traffic, with the same class of service as would be encountered on one of the ordinary branch lines of the territory west of the Missouri River, the cost per mile for local train service, equipment consisting of two cars and a locomotive, would be about 24 cents, including repairs, fuel, oil, labor, cleaning, etc.; this for passenger as well as baggage, mail and express service. Electric service equipment, consisting of one car and trailer, figuring that the density of traffic is sufficiently regular to support same seven days in a week, is estimated at about 18 cents a mile.

The gasoline service (mechanical drive only considered), consisting of one car and trailer, with baggage, mail and express service, would cost 15 cents per mile. The latter, of course, would be independent of whether service was six days or seven days per week, the cost simply depending upon the service rendered.

Railroads, therefore, have a choice of the various systems proposed, and a study of the conditions to be met and facilities afforded, both in the way of care and maintenance, as well as the train service proposed, will give the elements by which each situation will have to be studied. The motive power departments will be called upon to participate more and more in advising as to these questions, and in order to be qualified to undertake such work it is very desirable to introduce information and discussion of these subjects in this association.

The report is signed by Messrs. C. A. Seley, chairman; W. R. M'Keen, Jr., L. R. Pomeroy, C. F. Street, F. J. Cole.

Control of Electric Railway Motors.

Four patents were issued on June 5 relating to the control of electric railway motors. A scheme proposed by Mr. F. E. Chase for controlling the speed and torque by varying the voltage on single-phase motors is indicated in Fig. 1. Each car is provided with two auto-transformers, each of which serves to supply current at variable potential to one or more motors. Instead of series-paralleling the groups of motors to obtain a greater range of voltage, the inventor secures the same result by series-paral-

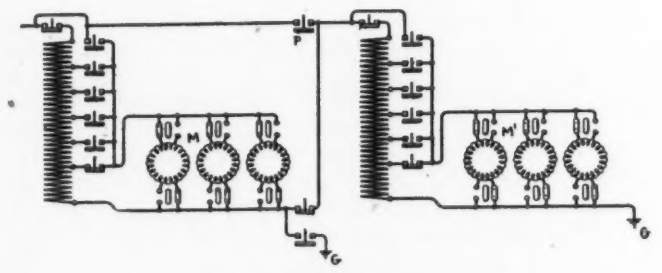


FIG. 1.—CASE CONTROL SYSTEM.

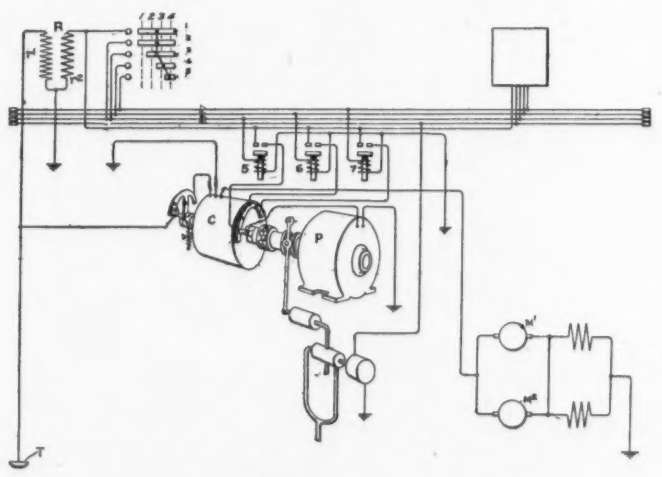


FIG. 2.—KROHN CONTROL SYSTEM.

leling the auto-transformers, by means of the contactor switches which serve to interconnect the transformers as desired.

Fig. 2 illustrates a motor control system devised by Sigvald Krohn, of Berlin, Germany. The voltage supplied to the motors

is varied by means of an induction regulator, the rotor of which is moved by pilot motor. A clutch, which mechanically connects the pilot motor with the induction regulator, is thrown in or out by a pneumatic device which receives compressed air from the braking system. The valve for admitting the air to the operating piston is controlled by an electromagnet. The circuits to this magnet, to the pilot motor and to the induction regulator are arranged as desired by means of a master controller.

When it is desired to regulate the motors on several cars of a train from a single point and no auxiliary source of current supply is provided, the control current must be obtained from

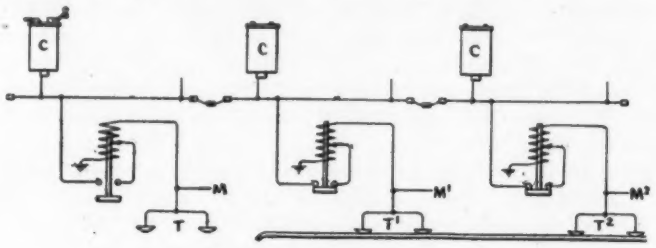


FIG. 3.—HILL CONTROL SYSTEM.

the collecting devices of the leading car or from a bus line. If the bus line consists of only a single wire connected directly to the several current-collecting devices, current may pass from one car through the bus wire and to the motors of another car, necessitating the use of a heavy wire capable of carrying motor current. Mr. George H. Hill proposes to connect the motor circuits of each car directly to the collecting device on that car and to employ the bus line exclusively for obtaining current for the control system and for lighting and heating, if desired, as indicated in Fig. 3. The three patents outlined above have been assigned to the General Electric Company.

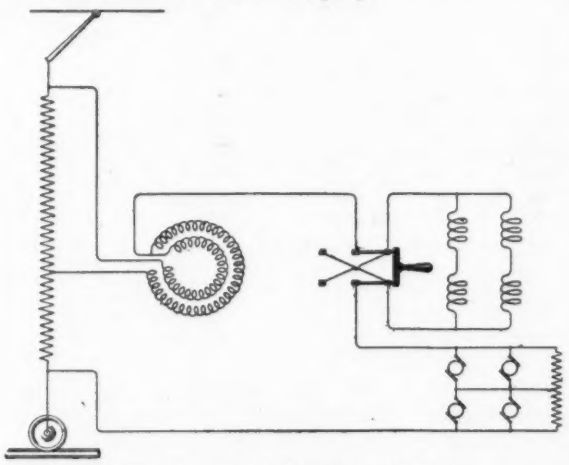
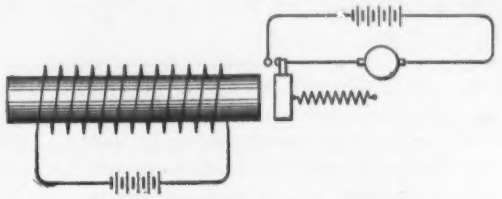


FIG. 4.—LAMME CONTROL SYSTEM.

Fig. 4 shows a system devised by Mr. B. G. Lamme for equalizing the potential differences between the terminals of the armature windings of single-phase motors when connected in series, in order to prevent the abnormal increase in potential across a motor in case the wheels should slip. As will be seen from the illustration an auto-transformer winding is connected between the outer terminals of the armatures and an intermediate point is connected to the armature winding terminals, which are joined together.

Electromagnetic Thermostat.

A patent issued June 5 to Prof. Elihu Thomson describes a method of utilizing the change in the magnetic permeability of certain alloys for the purpose of temperature indication and regulation. In the arrangement shown in the accompanying illustration a solenoid energized by current from a battery serves to set up a magnetic flux through the core which is made of a sensitive alloy, so that with constant excitation of the winding the magnetic flux through the core will undergo a substantial change when the temperature of the core reaches the critical temperature of the alloy. These changes in magnetic flux are used to change the position of the armature, thus opening or closing the local circuit through a motor which in turn performs such operative acts as are necessary to secure any desired temperature regulation. It is stated that a satisfactory alloy is obtained by using substantially 75 per cent copper, 24 per cent of an alloy of



ELECTROMAGNETIC THERMOSTAT.

manganese and aluminum combined in their atomic proportions, and one per cent of lead, as this gives an alloy the permeability of which changes at approximately 60° C.

CURRENT NEWS AND NOTES.

DATING OF TELEGRAMS.—Congressman W. W. Smith has introduced a bill which provides that every telegraph company shall show plainly on every telegram delivered the time of day at which the telegram was handed in at the company's office at the place from whence it came. A bill introduced so late would not at best appear to have much chance of passing this session.

TELEPHONES AND HORSE THIEVES.—The Indiana Horse Thief Detective Association announced recently that the association was thoroughly organized in all the counties of the State and had during the past three years decreased thieving and outlawry at least 75 per cent. The association officers stated that no agency had been more helpful in apprehending wrongdoers than the telephone. As soon as a theft is reported the telephones are used and seldom do the perpetrators get out of the county before being arrested.

MUNICIPAL LEAGUE OF INDIANA.—The Municipal League of Indiana, held its eighth annual meeting recently. It will ask the next Legislature to make numerous changes in the new cities and towns code as well as in the general law in matters affecting municipalities. One of the changes to be demanded is power to require interurban and steam railroads to light the streets over which their lines pass. The present law on that subject was not upheld by the Supreme Court. The subject of municipal ownership was discussed informally, the majority of the members of the League opposing it.

TELEPHONY IN BALTIMORE.—The opening of the new St. Paul exchange of the Chesapeake & Potomac Telephone Company restores telephonic communication in Baltimore to more than its former efficiency. Some 10,000 telephones were "cut over." The opening of this new building marks for Baltimore one of the most complete equipments for telephone service in existence. The new building has nine stories and a basement, and a steel frame extends through the roof to receive two additional stories, for which the building is planned. The building is 40 by 150 ft., and is fire-proof. It was planned especially for telephone services. The steel frame is one of the heaviest of any building in Baltimore, on account of the great weight to be supported, in the shape of apparatus and machinery, and the necessity for absolute rigidity. The cost with ground and without telephone equipment, was $500,000. As it stands the structure provides for two exchanges, with a capacity of 40,000 telephones. With the two additional stories it will have a capacity of three exchanges, or 60,000 telephones. The switchboard for the St. Paul exchange occupies the whole of the ninth floor. The terminal apparatus, which is already installed for two exchanges, occupies the entire sixth floor. The eighth floor is given up to operators' quarters, locker rooms, reading-rooms and dining-room. The cost of the St. Paul switchboard was $325,000, making the total cost of the building and first exchange $825,000. The exchanges open with 10,000 working lines. There will be 160 operators at the start, 300 when the board is full, and 1,000 when the whole building is occupied by the three exchanges.

PHYSICS AT CORNELL.—The new Rockefeller Hall of Physics at Cornell University, Ithaca, N. Y., is to be dedicated on Friday, June 29. This will coincide appropriately with the meeting there of the American Association for the Advancement of Science, beginning June 28.

SURGES IN UNDERGROUND DISTRIBUTING SYSTEM.—In the editorial with this title in our issue of May 26 the third and fourth paragraphs should have had a separate head, as they do not refer to the I. E. E. paper of Mr. Patchell, but comment on the presidential I. E. E. address of Mr. John Gavey.

ELECTRICITY AND GAS IN ITALY.—United States Consul-General de Castro at Rome, Italy, states that the amount of gas and electricity produced by the 228 gas works and 5,086 electric plants was, for gas, 74,271,628 cubic meters extracted from coal and 1,419 from mineral oil; for electricity, 132,126,051 kilowatts.

NATIONAL TELEPHONE CONVENTION.—The annual convention of the National Interstate Telephone Association will be held at the Auditorium Hotel, Chicago, June 25, 26, 27 and 28, when a large attendance is expected. A number of addresses and papers will be presented, but apparently none of them will be of technical or engineering interest, except perhaps that on Southern toll lines and exchange development. There will, however, be committee reports on standard operating rules and regulations, on standardization of equipment, and on standard forms of accounting. Mr. T. Gary, of Macon, Mo., will present a paper on the financing of small telephone properties.

THE CANADIAN ELECTRICAL ASSOCIATION meets this week at Niagara Falls, Canada, the dates being June 19, 20 and 21. An interesting programme has been provided and the business sessions will be conducted at the International Hotel on the American side, as the new Clifton is not yet ready. Among the papers to be presented at the convention are the following: "Steam Plant Accessories," by John T. Farmer; "The Power Plant of the Electrical Development Company of Ontario," by F. O. Blackwell; "The Electrical Plant of the Canadian Niagara Power Company," by H. W. Buck; "The Plant of the Ontario Power Company," by V. G. Converse; "Some Legal Propositions of Interest to Electrical Men," by Robert McKay.

ENGLISH MUNICIPAL PLANTS.—A special cable dispatch from London of June 16 says: "The National Civic Federation Commission, which has reached Liverpool from Birmingham, continues to receive municipal hospitality, as well as facilities for conducting its inquiry into public and private ownership. It commands respect for practical ability, although *The Municipal Journal* gives warning that the commission represents two parties in the Federation, one in favor of municipal ownership and the other standing for private enterprise, and that the reports produced after the investigation of municipal and private plants will be mutually destructive. The commission will reach London by the end of next week, after completing an examination of the tramway and gas plant at Manchester."

THE N. E. L. A. CONVENTION.—Secretary Eglin, of the National Electric Light Association, in a memorandum on the recent convention, says: "Although the increased attendance at the conventions of the National Electric Light Association, the greater interest taken in the sessions, and the very largely increased membership, speak volumes for the good work the association is doing, perhaps even more encouraging is the fact that so many of the delegates took occasion to look up the secretary for the express purpose of expressing appreciation of prompt and efficient responses to letters asking for assistance and information during the year. One member in particular stated that information he had asked for so late that he hardly expected to get it, came instantly and was of such importance that it settled in favor of his company the award of a 25-year contract for street lighting. This is only one of many similar acknowledgments, showing that the really valuable work goes on all the year round and benefits members even if they never attend a meeting."

ELEVATED RAILROADS.—It had been supposed that elevated roads had seen their finish in New York, but electricity has not only given them a new lease of life, but created a taste for more. Last week the New York Board of Estimate heard vigorous arguments for an elevated loop line at the Manhattan end of the Williamsburg Bridge, for the benefit of Brooklynites. This was opposed by residents on the east side affected by the elevated loop plan of Bridge Commissioner Stevenson. Mr. J. E. Swanstrom said that the beautiful electric elevated road in Berlin had added to the value of property, and he added: "This subway craze is going to die out. We are going back to elevated roads —not the present kind, but ornamental noiseless roads." Ex-Comptroller Grout insisted that an electric elevated loop was the only way to "relieve the unbearable congestion of the bridges."

PUBLIC DUTY OF ENGINEERS.—At the laying of the cornerstone of the new Engineering Building of the University of Tennessee, President Humphreys, of the Stevens Institute of Technology, said: "The questions before the country to-day which are causing the most concern are largely industrial and technical, and hence the opportunities for misapprehension on the part of the public are greatly, dangerously, increased. I have thought much on the subject and not unlikely my opinions may be colored by my training—but it does seem to me that if we are in danger through the lack of information and misinformation of the public, sedulously cultivated by the yellow journals, the engineers of the country are peculiarly qualified—or should be—to combat this ignorance, and, therefore, they cannot avoid grave responsibility in this connection both as to the present and the future. It is coming to be more and more the practice to place technically trained engineers in charge of our industrial establishments. These men, then, should be prepared to recognize that capital and labor have their respective rights in which they should be protected, and should especially be ready to recognize that the contests between capital and labor—so-called—are frequently contests between leaders who manipulate capital and labor for their own ends."

KENTUCKY INDEPENDENT TELEPHONISTS.—At Louisville, Ky., on June 14, the annual meeting of the Kentucky Independent Telephone Association was held at the Louisville Home Telephone building. Companies in most of the towns and cities in the State were represented. It developed that in the State there are about 150 corporations giving independent telephone service, with 50,000 subscribers. Subjects of importance to the independent telephone interests were discussed and the delegates to the National Interstate Telephone Association convention, to be held in Chicago on June 26, 27 and 28, were elected as follows: J. A. Armstrong, president and general manager Louisville Home Telephone Company, Louisville; M. S. Taylor, general manager Fayette Home Telephone Company, Lexington; J. W. Chambers, secretary and general manager Old Kentucky Telephone Company, Winchester; R. T. Hickman, Henderson Telephone & Telegraph Company, Henderson; M. J. Thomas, Shelby Home Telephone Company, Shelbyville. New officers for the ensuing year were elected as follows: M. B. Overly, general manager Central Home Telephone Company, Louisville, president; H. K. Cole, secretary and general manager the Kentucky and Indiana Telephone Company, Owensboro, secretary; M. J. Thomas, Shelbyville, vice-president first district; Frank M. Hoge, Hopkinsville, vice-president second district; M. S. Taylor, Lexington, vice-president third district; P. H. Murphy, Nicholasville, vice-president fourth district; J. W. Brambers, Winchester, treasurer. The State was divided into four districts and arrangements were made to hold in each district at least four meetings a year to the end that the independent telephone movement might be fully discussed, ideas exchanged and a systematic and intelligent campaign carried on for its development and extension.

TOO MUCH LIGHT.—The participants in the recent meeting of the National Electric Light Association at Atlantic City were very much pleased with the festoons of incandescent lamps along the boardwalk, and the general electric lighting effect. But it is hard to please everybody, and in some of the more retired parts of the ocean front the hotel proprietors and visitors have asked that the lights be turned off in order that the moonlight can be enjoyed. It is said that the City Council will probably grant the request.

AUSTRALIAN ELECTRICAL GROWTH.—U. S. Consul-General John P. Bray supplies from Melbourne several Australian industrial items of interest as follows: There are some 50 miles of electric traction in operation at present in Australia, the lines being short ones in Melbourne, Sydney, Hobart, Ballarat and Bendigo. The further extension of electric lines is under consideration more or less by the State governments of most of the States, especially Victoria, New South Wales, West Australia and South Australia (where the electrifying of the street-car lines of Adelaide is contemplated). In Victoria many of the suburban municipalities have under consideration the construction of lines, and generally much interest is being displayed in that direction. There is no doubt that in the near future the number of lines in operation will be very largely increased both in the way of new lines and the conversion of old ones. Manganese and decarbonized steel, and copper wire are not manufactured in Australia, the supplies coming from the United States, England and Germany, with America leading.

EXCELLENT FOREIGN TRADE.—Note has been made in these columns from month to month of the excellent condition of foreign trade: The foreign commerce of the United States during the fiscal year which ends with this month promises to exceed in both imports and exports that of any earlier year. The details of ten months of the year's commerce have been announced by the Department of Commerce and Labor through its Bureau of Statistics, and should May and June show as large a monthly average as that of the ten months for which the record has been made, the imports will be 1,225 million dollars, and the exports 1,786 millions, or a total of a little more than 3 billion dollars. The figures of the fiscal year 1905 exceed, both as to imports and exports, those of any prior year, and the fact that the recorded imports of ten months of 1906 exceed by nearly 100 millions those of the corresponding months of last year, and that exports exceed by over 200 millions those of the corresponding months of last year, suggests that there can be no doubt that the fiscal year 1906 will make the highest record ever shown in both imports and exports, and therefore the largest total of foreign commerce. The gain in electrical apparatus and instruments has been quite considerable.

WOMEN VOTE FOR MUNICIPAL PLANT.—A special election was held in Potsdam, N. Y., June 14, at which a large number of women took advantage of their right to vote on a proposal to bond the village for $24,000 for the construction of a municipal lighting plant to supply street lights only. Fully one-third of the votes were cast by women, and their votes in favor of municipal ownership, according to a special dispatch from Potsdam, carried the proposition by a majority of 58. A year ago last March a proposition to raise $40,000 for a lighting plant to supply street lights and lights for residences, etc., was carried by a small majority. A few weeks later the Potsdam Electric Light and Power Company, which now lights the village, got an injunction restraining the village from proceeding with the construction of the municipal plant, on the ground that it had not procured permission from the State Gas Commission. This injunction was made permanent by a decision of Justice H. T. Kellogg, and the Appellate Division affirmed this judgment. The village has appealed to the Court of Appeals, where the case is now pending. The Municipal Ownership party, finding that the village could bond itself for a strictly municipal plant, brought about the special election on June 14.

MR. CARNEGIE'S TELEPHONE SYSTEM.—Mr. Andrew Carnegie has purchased a complete private automatic telephone exchange of twenty lines, for his Scottish estate, Skibo Castle, Scotland. Mr. Carnegie's sister-in-law, Mrs. Lucy Carnegie, has an automatic exchange of twenty-two lines on her estate, Dungeness, on Cumberland Island, just off the coast of Georgia. The Dungeness exchange has been in operation over two years, and Mr. Carnegie was so pleased with its working that he decided to use the same system at Skibo Castle. Mr. K. B. Weatherbee, Mr. Carnegie's mechanical engineer, was in Chicago during the latter part of May to familiarize himself with the system of the Automatic Electric Company and expects to install the exchange at Skibo Castle in August. The initial installation will be for thirteen telephones, five of which will be in the castle, one in the estate office, two in the stable and garage, one in the gamekeeper's lodge, one in the gardener's lodge, one in the golf house, one at the dock on Dornoch Firth, where Mr. Carnegie's yacht is kept, and one at the natatorium. The estate is about ten miles square.

THE INDEPENDENT ELECTRICAL CONTRACTORS ASSOCIATION OF GREATER NEW YORK, an organization of more than 200 of the prominent contractors, will have its second annual outing and clam bake on July 7th, at J. M. Donnelly's Boulevard Hotel, College Point, L. I., N. Y. Special prizes will be awarded to bowlers and winners in base ball and other games. The Second Battery Band, headed by G. E. Fuller, will furnish the music. The committee in charge are Messrs. Frederick G. Shafer, A. Neuberger, B. Glidden, E. Christesen and C. Hagemeyer. The officers of the Association are Messrs. T. Whitehead, president; A. Neuberger, vice-president; F. G. Shafer, treasurer; C. A. Christesen, financial secretary; F. W. Cohn, recording secretary; B. Glidden, sergeant-at-arms.

THE ORIGIN OF HELLO.—A correspondent of the *New York Times* says: A distinguished scholar and philologist writes me the following, which may be of interest to your readers: "'Holler' is the word halloo in its proper form, and halloo is a root common to all Indo-European languages. The root is spelled, in the comparative grammar of the Indo-European language, by Heinrich Fick, HLU, and is pronounced almost exactly h-loo. It appears in whole classes of words signifying to call (call itself being derived from that root) and to hear and meaning very nearly, 'stop and listen to me.' The first word in the old Norse Edda is HLIOTHS, and it means a listening silence, so that the concrete meaning of halloo is to be in a state of listening silence, or 'be still and listen.' I think that this is one of the most interesting philological contributions to the literature of the telephone, illustrating the exact meaning of the word 'hello.'"

DEVELOPMENT IN ITALY.—It is stated that an impetus has been given in Italy to water-power studies and electrical transmission by the news that the government, under the direction of the King, whose interest in such practical enterprises is notably keen, will invite the two great railway lines, Ferrovie Meditteraneo and Ferrovie Medidionali, to devote a large part of 1907 to the question of electrical traction and to take up various projects for trials on a large scale. In Northern Italy nearly all the small cities and a large number of villages are supplied with electric light, while many of them have installations of hydro-electrical power. Among the cities of from 10,000 to 50,000 inhabitants so equipped are Vercelli, Novara, Pavia, Bergamo, Brescia, Verona, Voghera, Alexandria, Mantua, Vicenza and Intra, many of them being in the Milan consular district and being prominently known for the importance of their manufactures and for their extensive contributions to the total of exports invoiced through this consulate. Hydro-electrical installations have played a strong part in the commercial advancement of these thriving towns.

WIRELESS AT SAN FRANCISCO.—A 216-ft. mast has been erected on Russian Hill by a local wireless telegraph company. It will be used as a station to connect San Francisco with a branch of the same system in Colorado.

THE WORD "AEROGRAM" is in growing use to designate a message sent by means of wireless telegraphy. The Pittsburg *Index* in approving it says: "Aerogram is well formed from the Greek words meaning 'air' and 'to write,' and admirably designates 'writing through the air.' It is easily pronounced, concise and to the point, and is appropriately analogous to the word 'telegram.' 'Aerogram' should come into universal use. Educated persons appreciate a well-formed word. If the editors of daily papers made 'aerogram' an office rule, the public would soon adopt it."

THE SIMPLON LOCOMOTIVES.—Cable dispatches from Switzerland say that the electric locomotives for the Simplon tunnel, chilled by the outdoor temperature, and entering the warm extremely moist atmosphere of the tunnel, have experienced short-circuits through the volume of condensation and the breaking down of the insulation. If true, this should prove easy to remedy; and it will certainly not be necessary to revert to steam, as suggested. The trip over the Mont Cenis and St. Gothard routes is always spoiled by the smoke and gases of the steam locomotives in the endless tunnels.

NEW YORK ELECTRICAL SOCIETY closed a very successful year with a smoker at the Hotel Astor on June 13 under the chairmanship of President Barstow. An excellent concert was given, with a collation. The membership of the society is well over 600 and the finances are in good shape. The following is the result of the annual election: President, George Herbert Condict; vice-presidents, Robert T. Lozier, Walter F. Wells, P. G. Gossler. The vice-presidents elected 1905 for two years are: H. G. Stott, Putnam A. Bates, Max Loewenthal; secretary, George H. Guy; treasurer, H. A. Sinclair. The society is taking offices in the new United Engineering Building, and believes that the enjoyments of such headquarters will bring it a large accession of membership.

MONEY SUNK IN MUNICIPAL.—Middleboro, Mass., is in serious difficulties as to its municipal plant, and according to the Boston *Herald* "from the very outset of the purchase the town has been unfortunate." In thirteen years the community has sunk $118,000 in its gas and electric light plants, and the end is in sight. Apparently both plants are pretty nearly in the condition of junk, and it is now a question of large new expenditures or abandonment. "The present board of commissioners cannot be blamed for the mistake made at the purchase nor for the management of the plant in its infancy, but it has been claimed that in many cases they have concealed matters which if divulged in town meeting would have given the citizens a chance to help and not hinder them. The affair has narrowed down to the question of whether the town will continue to pass out money to support the plant or whether the abolishment of municipal ownership is in sight. Many of the most influential citizens are in favor of selling the whole plant and buying lights on contract like the other small towns in the State."

CANADIAN COMMISSION APPOINTMENTS.—Two of the commissions made necessary by the enactments of the last session of the Ontario Legislative Assembly are now complete and ready to commence the labors which will be required of them. These are the new Hydro-Electric Commission, whose functions will enable the municipalties of the province to secure electric energy at an economical rate, and the Railway and Municipal Board. Premier Whitney has announced that it had been decided that the former body should be composed of Hon. Adam Beck, of London, the Minister who has been so closely identified with the power question of Ontario; Hon. J S. Hendrie, of Hamilton, and Cecil B. Smith, who is now chairman of the Temiskaming & Northern Ontario Railway Commission, and consulting engineer of the commission of inquiry. Hon. Mr. Beck will naturally be the chairman of the Hydro-Electric Commission. The gentlemen who will with James Leitch, K.C., compose the Ontario Railway and Municipal Board, are: Andrew B. Ingram, who represents East Elgin in the Dominion House of Commons, and Henry Norman Kitson, of Hamilton. The gentlemen will receive $4,000 a year for their services on the board. Their secretary, H. T. Small, a barrister, will be paid a stipend of $2,000 a year.

NEW STEVENS LABORATORY.—The Stevens Institute of Technology, Hoboken, N. J., is growing rapidly under the vigilant fostering care of President Humphreys, and last week there was added to its equipment, with due ceremonies, the Morton Memorial Laboratory of Chemistry, built by the alumni as a memorial monument to the late Dr. Henry Morton, the physicist, chemist and electrician, first president of Stevens. The new building cost $150,000 and is believed to be the best equipped structure of its kind in the United States. In general charge of it will be Dr. Thomas B. Stillman, professor of chemistry at Stevens, well known for his original researches and results. The laboratory is the first building to be placed on the recently acquired campus at Castle Point, and adjoins the new athletic field.

ALLEGED TELEGRAPH FRAUDS.—A San Francisco grand jury brought in last week a charge against the telegraph companies of fraud of the grossest kind in accepting money for messages at the time of the disaster, and then forwarding them by mail and messenger instead of by wire. The jury went so far as to estimate that $1,000,000 had been collected in this manner. This charge has been denounced as an outrage by President Clowry, of the Western Union, and Vice-President Baker, of the Postal, and certainly does not conform with the facts as known at this end of the line, or with our own personal experience at the hands of the officials of both systems. The wonder is that the service was as good as it was, and we know of our own knowledge how officials and operators worked day and night to clear the traffic, while warning was given of liability to great danger. Col. Clowry says: "We supplied 23,000 newspapers with bulletins without charge for weeks. We forwarded free all messages dealing with relief; we telegraphed a great deal of money and took none ourselves. That seems to me a very substantial contribution to the relief fund, and our wires are always open free to the public on occasions of such disasters as the eruption of Vesuvius, the Russian massacres or the Baltimore and Galveston catastrophes. Many of our men stayed at work in San Francisco and did not even look after the safety of their families."

NIAGARA POWER IN BUFFALO, thanks to such men as Adams, Huntley, Rankine and Wickes, is now a greater reality than the pioneers imagined, and two-thirds of the motive power of industrial Buffalo comes from the falls. The Cataract Power & Conduit Company is erecting a new transformer house of 25,000 hp capacity, on the high bank of the river at Niagara Street and Front Avenue, Buffalo, to receive the power of the Canadian Niagara Power Company, Niagara Falls, by two power transmission lines running along the Canadian side of the Niagara River from the power house at the falls to Fort Erie, opposite Buffalo, whence entrance to the city will be made by an overhead span crossing the Niagara River at a height of 150 ft. above the river, suspended from shore towers 210 ft. in height. Connection already exists between the two power houses of the Niagara Falls Power Company on the American side and the power house on the Canadian side, and these three plants are now connected with Buffalo by four transmission lines along the American side of the river to the present terminal station, which will be known as Terminal House A. The new terminal power station, which will be designated as Terminal House B, will be connected with the old terminal station by underground cables, making a complete loop system for the transmission of Niagara power to Buffalo. The initial equipment of the new terminal station will consist of six 3,000-kw transformers, stepping down from 22,000 volts to 11,000, at which pressure, energy is distributed underground to five sub-stations located at various points about the city, where the pressure is again transformed to 2,200 volts for distribution for commercial use. The present productive capacity of the three power houses connected by this system is 155,000 hp.

Winnipeg, Manitoba, 60,000-Volt Hydro-Electric Plant.

By V. D. Moody.

WINNIPEG, the metropolis of northwestern Canada, the capital of the Province of Manitoba, in the richest wheat belt on the Canadian soil, with a population of 100,000, has under completion one of the most modern water power constructions on the continent.

The City of Winnipeg is the distributing center of the Canadian Northwest, which is demonstrated by the great extensions and shipping facilities offered by the Canadian Pacific and the Canadian Northern Railway Companies, and the projections of the Grand Trunk Pacific Railways.

The possibilities of a manufacturing center were quickly grasped, and the project was taken in hand in 1901 by the Winnipeg General Power Company to harness the waters of the Winnipeg River for general power purposes, at a point distant a few miles from Lac du Bonnet, which is on a branch line of the Canadian Pacific Railroad, distant 65 miles from the City of Winnipeg.

In 1905 the Winnipeg Electric Street Railway Company, operating a steam station and controlling the street railway system, the general house lighting and power distribution, amalgamated with the General Power Company and became incorporated as the Winnipeg Electric Railway Company.

The advantages to be derived from such a hydraulic development were readily appreciated, due to the high cost of fuel for the operating expenses of a steam plant and the necessarily enormous cost of energy to the consumer. The cost of energy for operating the steam plant to the consumer being 12½ cents per kw-hour for general motor work and 20 cents per kw-hour for lighting, with the usual discounts for prompt payments of bills, which price with the new development, will be reduced approximately 50 per cent, with discounts for prompt payments.

The power house is located on the opposite side of the Winnipeg River, from Lac du Bonnet station. Difficulties experienced in conveying material to the site selected were overcome by building an eight-mile corduroy road from the river to the power house, and a similar eight-mile road from the power house to the headworks. The heavier electrical and mechanical machinery had to be conveyed in the winter when the ground and river were hard frozen, as the means of conveyance across the river at other times consisted of a small tug and barges.

To obtain the necessary water, a channel had to be cut to the upper river near Otter Falls, 120 ft. wide, with a clear depth of 8 ft. at normal low water, the channel being 8 miles long with a drop of 5 ft. to the mile, equalling a total head of 40 ft. In cutting this channel it was essential to blast with dynamite about 447,000 cubic yards of granite, which was lifted out of the passageway by means of derricks. With the rate of flow of water through this channel and the available head there can be developed about 30,000 electrical hp.

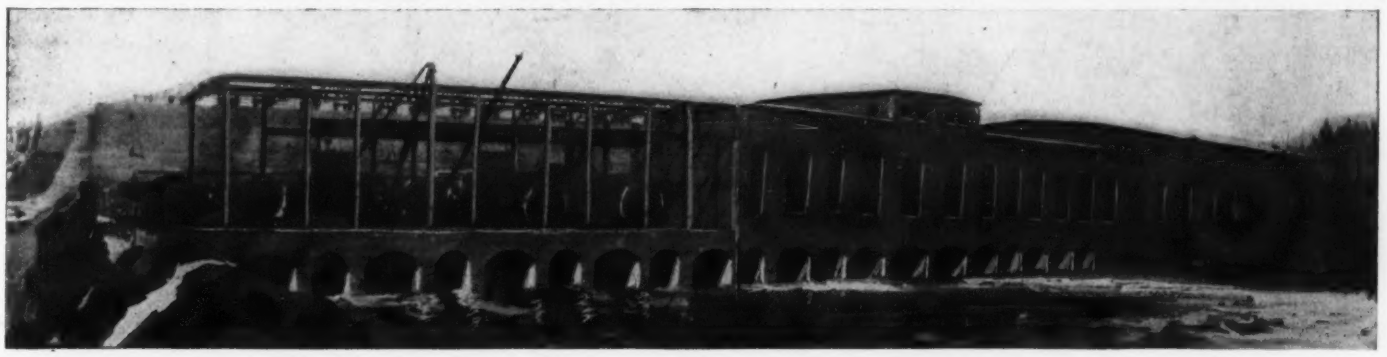


FIG. 1.—VIEW OF POWER HOUSE, SHOWING EXTENSION.

The greater part of the winter of 1902 was devoted to transporting the necessary material to begin operations in the spring. The development began with the excavations for the dam and tail race. At the point where the dam is located there is a natural fall, and the dam crosses almost at the crest.

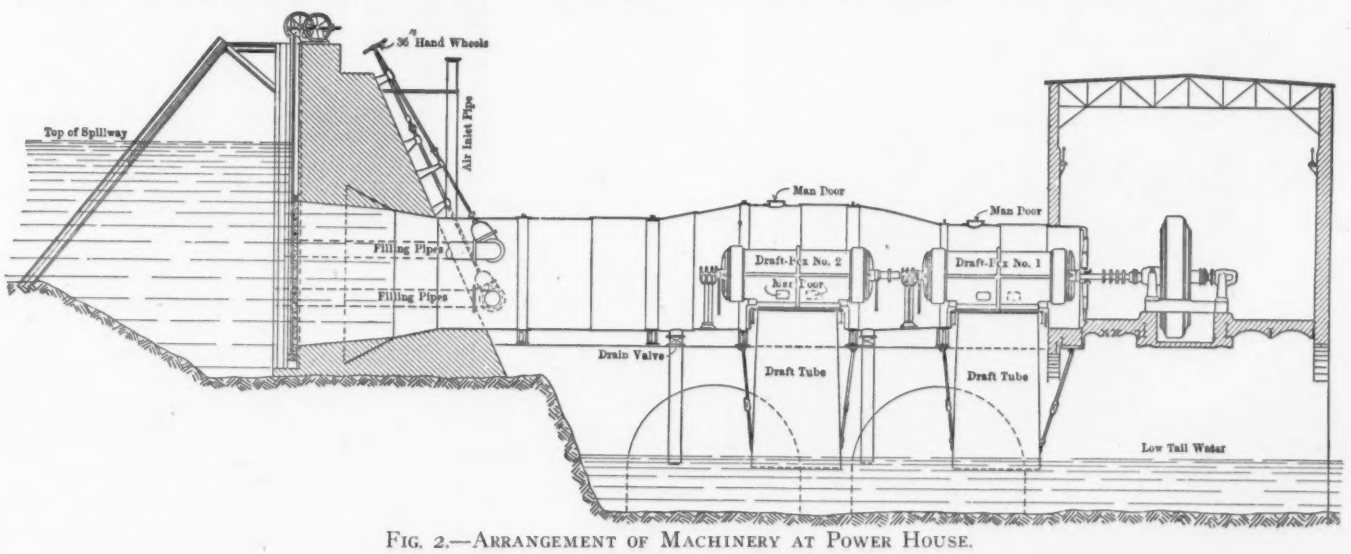


FIG. 2.—ARRANGEMENT OF MACHINERY AT POWER HOUSE.

Before starting these works it was essential to back up the water, which maintained from levels the year around at the point where the channel opened into the river, eight miles from the power house, an average elevation of between 8 and 9 ft. This was done by means of a cofferdam.

The actual amount of granite excavations made and concrete constructions for foundations in cubic yards is given in the following tabulations:

Granite excavations.	Cubic yards.
Tail race	26,442
Power house	78,000
Head race	67,608
Intake	274,503
Grand total	446,553

Concrete construction in cubic yards: mixture, one part cement, three parts sand, five parts broken stone.

Forebay wall	6,621
South wing wall	2,416
North wing wall	2,369
Transformer house foundation	1,915
Power house foundation	4,503
Overfall dam (spillway)	4,600
Boom piers to catch debris, consisting of concrete piers spanned by floating logs	277
Controlling works	1,200
Ice rack foundations	110
Grand total	24,011

As soon as excavations had been made, the foundations were laid for the power house requiring 4,503 cubic yards of concrete,

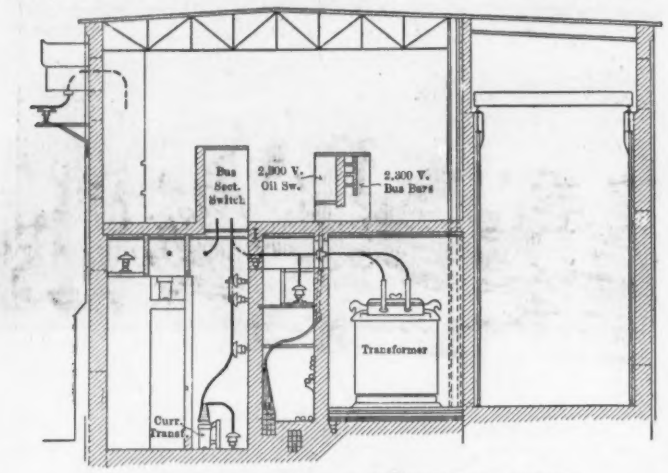


FIG. 3.—CROSS-SECTION OF TRANSFORMER HOUSE.

and for the transformer house, an extension to the power house, requiring 1,915 cubic yards of concrete. The dimensions of the power house between inside walls are: Length, 330 ft.; width, 31 ft. 9 in.; height from foundation, 39 ft. 7 in. Transformer house: Length, inside walls, 176 ft.; width, 53 ft. 1 in.; height, 36 ft. 9 in.

The buildings are absolutely fire-proof, being built of structural steel and brick throughout.

The main units in the power house consist of four 1,000-kw and five 2,000-kw, revolving-field, 60-cycle, 2,300-volt, three-phase

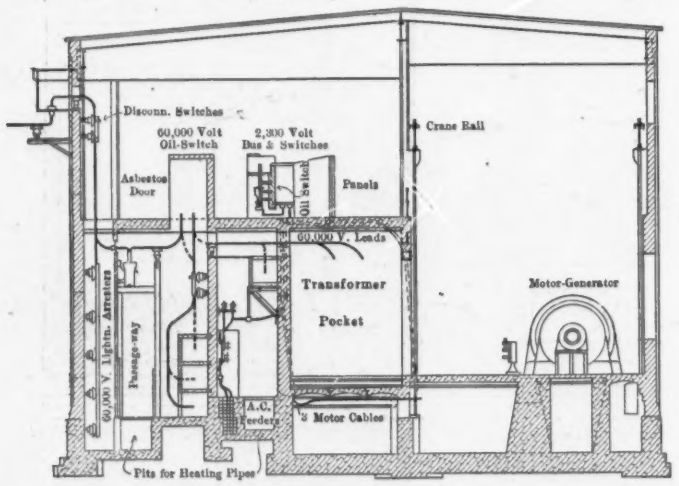


FIG. 4.—CROSS-SECTION OF SUB-STATION.

generators, coupled to McCormick turbines with Lombard governors; two 100-kw, 125-volt, direct-current exciters, coupled to the same type turbines; and two 175-kw, 125-volt exciters, coupled to three-phase, 2,300-volt induction motors.

The following tabulations give the generating station capacity:

No.	Water wheels hp.	Generators kw.	Speed r.p.m.	Voltage.
4	1800	1000	200	2300
5	3600	2000	180	2300
2	200	100	600	125
2	Motor driven.	175	514	125

The generators have a manufacturer's guarantee of efficiency at full load of 95.5 per cent, regulation in percentage of full load volts, 4 per cent.

It is well to mention here that the turbine gates are protected by ice racks to keep out ice, logs, etc.

The switchboard is of black enameled slate and instruments of dull black finish. It is of the well-known benchboard type, and is located on a gallery about in the middle of the main generator room, where the operator can readily observe everything happening on the generator floor. The board sets on wooden beams. The controlling wires to the motor-operated oil switches, which switches are located in a gallery comprising the second floor of the transformer house, are run in 1¼-in. enameled iron conduit, as are also the generator and exciter field circuit leads. The exciter armature leads are run from the machines to the switchboard in 2½-in. pipes. The generator armature leads, consisting of cambric insulated cables, are run in 3½-in. tile duct to their respective oil switches—all of the conduit and duct being run in the concrete floors.

A general cross-section of the transformer house is shown in Fig. 3. The low and high-tension oil switch cells are on the second floor of the switch gallery. The switches are all three-phase, motor-operated, and each phase is separated by a 2-in. soapstone slab, the cells of the switches being separated from each other by 8-in. pressed brick walls. The low-tension bus compartments are directly behind the low-tension oil switches, each bus being separated by a concrete slab and each connector from switch to bus being separated by a 4-in. pressed brick partition. The low-tension buses are sectionalized by a motor-operated oil switch. The high-tension switch cells are placed 6 ft. 9 in.

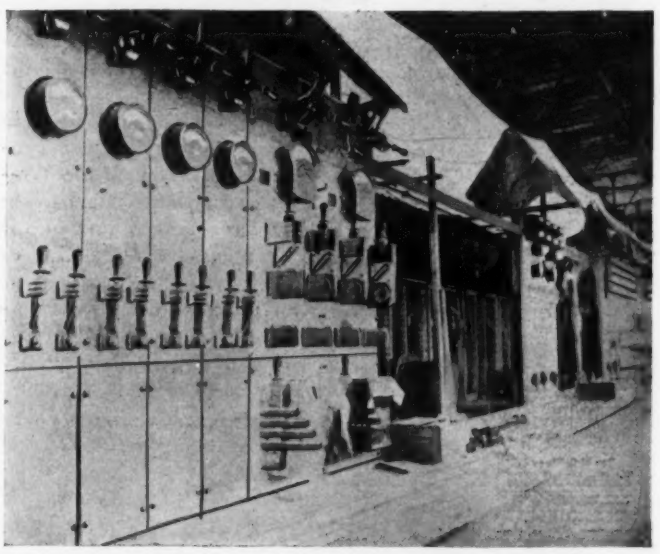


FIG. 5.—SWITCHBOARD IN SUB-STATION AT WINNIPEG.

in front of the low-tension switches and consist of five transformer, one bus sectionalizing and two outgoing line motor-operated, 60,000-volt oil switches, their respective compartments and phases being separated by an 8-in. pressed brick wall. Each of the low and high-tension oil switches, low-tension bus compartments, lightning arresters and high-tension bus compartments is provided with an asbestos door.

From the low-tension buses, connectors run to the five low-tension transformer oil switches, two of which are on one side of the bus sectionalizing switch and three on the other side, the former and one of the latter controlling three banks of 1,800-kw transformers, and the other two switches controlling two banks of 830-kw transformers. From these switches cambric insulated cables are run through 3½-in. tile duct embedded in the concrete floor, to the low-tension side of the transformers themselves, which are located in brick compartments or pockets directly under the switch gallery, each transformer being in a separate pocket with a 12-in. brick wall on each side. The front of each pocket is provided with Kinnear steel doors.

There are fifteen transformers comprising five banks, consisting of two banks of 830 kw and three banks of 1,800 kw. The secondary and primary coils are provided with taps for the following voltages: 2,200, 2,300, 2,400 volts secondary; 40,000, 50,000, 60,000 volts primary. The transformers are arranged for delta connections on both the high and the low-tension side; the voltage in

operation is stepped up from 2,300 volts to 60,000 volts for transmitting to the sub-station at Winnipeg over a distance of 65 miles.

The 1,800-kw transformers bear a manufacturer's guarantee of efficiency at full load of 98.2 per cent; regulation non-inductive, 1 per cent; regulation, 90 per cent power factor, is 2.5 per cent. The 830-kw transformers have a guarantee of full load efficiency of 97.7 per cent, the regulation to be the same as that of the 1,800-kw transformers.

For connecting up a bank of transformers, porcelain wall tubes 2½ in. inside diameter, 12 in. long, are placed between pockets, union couplings being provided on each transformer so that any one of a bank may be readily disconnected and two transformers run on an open "delta." The high-tension leads from the transformers out of the pockets to the high-tension delta consist of special copper tubes insulated in the same manner as the high-tension leads of the transformers. They are run on 60,000-volt porcelain insulators (tested for 120,000 volts) supported in the pocket by brackets and suspensions from the I-beams, and pass through the 16-in. brick back wall of the pocket through high-tension bushings, similar to those supporting the high-tension leads of the transformers.

Between the transformer pockets and the high-tension room all of which are on the first floor of the transformer house, there is a passageway separated from the above-mentioned compartments by 16-in. brick walls, in which the high-tension delta compartments are located 12 ft. from the floor level. The insulators for carrying the wires, consisting of No. 2-0 hard-drawn copper, are supported by galvanized-steel pins in a three-inch concrete slab, each outgoing phase to the high-tension transformer motor-operated oil switch, being separated in the delta compartment by a 4-in. pressed brick partition, all delta connections being made by copper connectors which may be readily disconnected. From the delta compartments the high-tension leads run on 60,000-volt insulators to the transformer oil switches and from the switches to the high-tension buses. The high-tension buses are separated by 3-in. concrete slabs, carrying 60,000-volt insulators, faced by a 4-in. pressed brick wall. Where the high-tension wires run to the oil switches located on the second floor, each phase is separated by a 2-in. pressed brick wall faced with a brick buttress from the first floor to the switch gallery.

FIG. 6.—MAIN FLOOR OF POWER HOUSE DURING CONSTRUCTION.

The lightning arresters are located in compartments of pressed brick in the high-tension room directly opposite the high-tension buses, and as in the case of the high-tension cells they are provided with asbestos doors about 7 ft. high. The lightning arresters are well-grounded by a copper plate embedded in the mud in the tail race.

Disconnecting switches are provided between all oil switches and buses, both high and low-tension. The high-tension disconnecting switches are mounted on caps cemented to the heads of 60,000-volt insulators grouted by cement in the brick walls.

The transformers being of the oil and water-cooled type, there is provided a duplicate system of piping for both water and oil, valves being provided so that any one transformer or any bank can be cut off. The water piping is tapped from the tube of the exciter water wheel. The oil system is operated from oil tanks in the basement of the generator room by means of an air compressor driven by a three-phase, 220-volt induction motor, which was furnished by the Canada Foundry Company. There are provided three oil tanks, a receiving, a supply and an emergency.

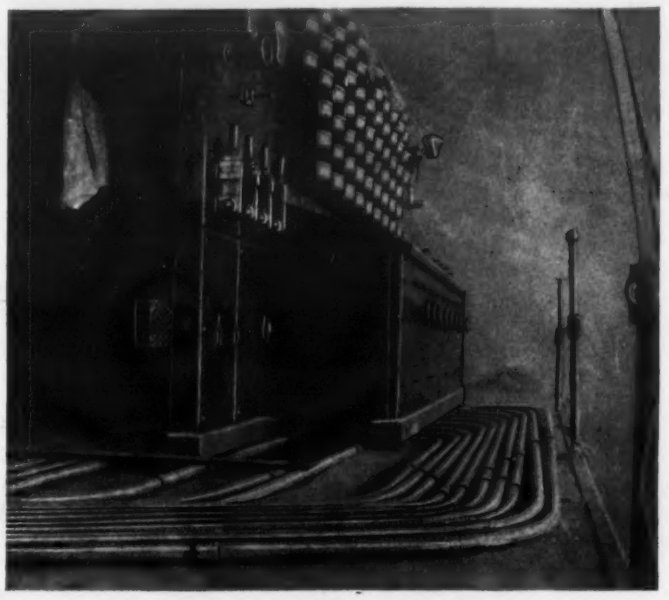


FIG. 7.—VIEW OF SWITCHBOARD AT POWER HOUSE, SHOWING CONDUITS.

The station lamps and auxiliary motors are operated from three-phase, oil-cooled transformers with secondary at 115 and 230 volts, controlled by an oil switch. Incandescent lamps are used throughout.

There is also located in the station a permanent water rheostat made of concrete with iron plates forming the three phases, which rheostat is connected to the buses by an oil switch.

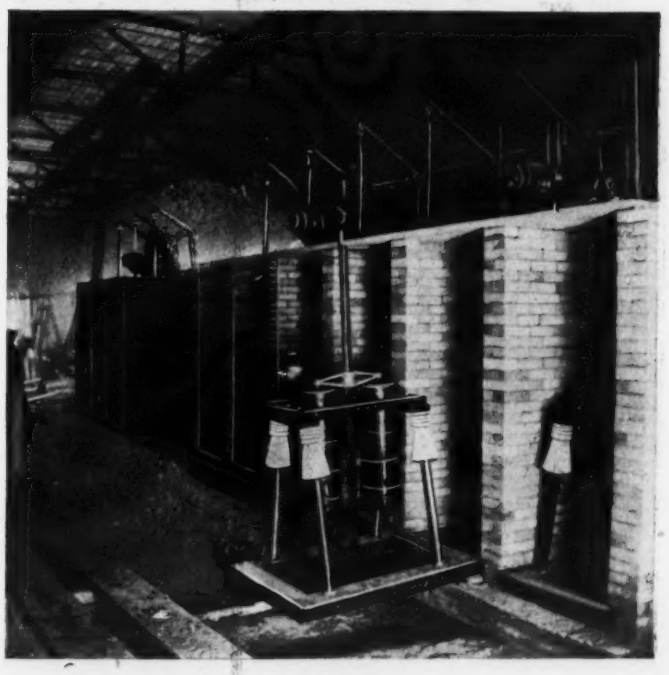


FIG. 8.—INSTALLING 60,000-VOLT MOTOR-OPERATED OIL SWITCHES.

From the power house there are run duplicate transmission lines of No. 2-0 cable, with a hemp center, on steel towers to the sub-station at Winnipeg. The steel towers are similar to those used by the Toronto & Niagara Power Company, recently described in this paper. In erecting these towers many difficulties were experienced, due to the nature of the country to be traversed,

which necessitated the lines being paralleled by a corduroy road for several miles. Twenty-one standard towers 40 ft. high had to be placed on piles near the Lac du Bonnet end between the Winnipeg River and the power house. The line crosses the Winnipeg River with a span of about 760 ft., on 72-ft. towers, each weighing about six tons, with a sag in the line of about 23 ft. at 50° F. The standard towers are spaced 500 ft. apart, are 40 ft. high and the line sags about 14 ft. at 50° F. Each tower weighs about 2,400 lb.

There are four railroad crossings. The Red River crossing at Winnipeg near the sub-station has a span of about 1,100 ft., the towers being 105 ft. high, the sag in the line about 45 ft. at 30° F. Each 105-ft. tower weighs about 15 tons. The railway and the river crossing towers are built up on concrete footings. All of the towers are well grounded and are provided with lightning arresters, consisting of steel rods with ends pointed, bolted to the verticals and projecting mid-air above the highest point of the line. The transmission line, which has 10 complete transposition spirals, is paralleled by a telephone line of No. 8 hard-drawn copper wire, on the towers, which is transposed at each tower. The telephones are of the iron box type, purchased from the Mayer & Englund Company, Philadelphia, with 2,500-ohm ringers, so arranged that when the door of the telephone is closed the ringer is cut out of the circuit. These instruments are located every five miles along the line. There will be six patrolmen who will also be provided with watch-case transmitters for testing purposes.

Where the line leaves the power house and where it enters the sub-station, there are left in the wall of the building openings in which are mounted 60,000-volt insulators, and on the outside of the buildings there are provided hoods of expanded metal with cement coating, the bottom of which carries a high-tension Locke bushing, using 24-in. tube which has withstood test voltage of 130,000. The lines pass through these bushings over insulators supported on brackets to the towers. The line was designed for a drop not to exceed 10 per cent.

The general arrangement of the sub-station at Winnipeg is

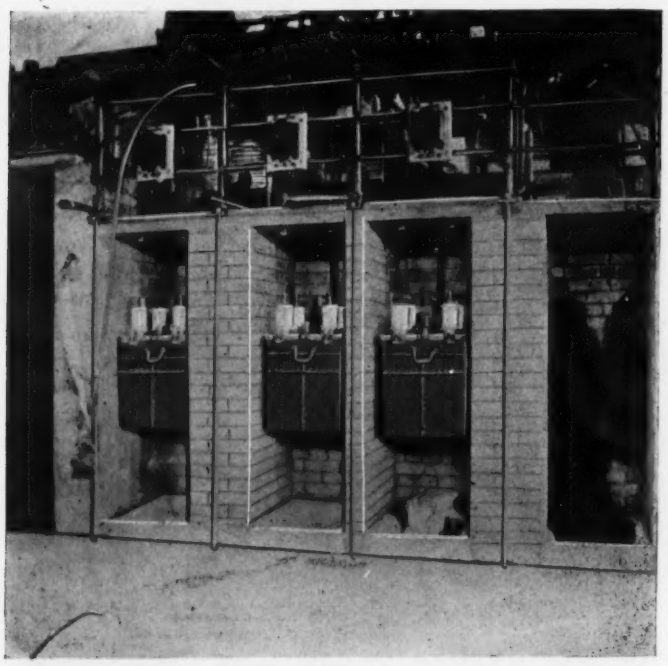


FIG. 9.—LOW-TENSION SOLENOID-OPERATED OIL SWITCHES AT WINNIPEG.

similar to that of the transformer house at Lac du Bonnet, the building being of brick and steel structure, having a length of 176 ft. and a width of 70 ft. 6 in., the height being 49 ft. 10 in.

The high-tension switches, the low-tension transformer and bus sectionalizing switches are of the motor-operated, oil type. The feeder and motor-generator oil switches are of the solenoid-operated type. Disconnecting switches are placed between the high-tension and the low-tension buses and the oil switches.

The switchboard is of blue Vermont marble and is provided with dummy buses. It consists of the following panels arranged in the order designated: two two-circuit, direct-current power feeder panels, each circuit having 200-amp. ammeters, seven railway single circuit, direct-current panels, three of which have 1,200-amp. ammeters; four having 500-amp. ammeters; two two-circuit railway feeder panels, one of which has two 500-amp. ammeters, the other one 500-amp. and one 750-amp. ammeters; five two-circuit, 600-amp. railway feeder panels; seven 800-kw, 600-volt, direct-current railway generator panels; seven 800-kw, 2,300-volt, three-phase synchronous motor panels; five two-circuit,

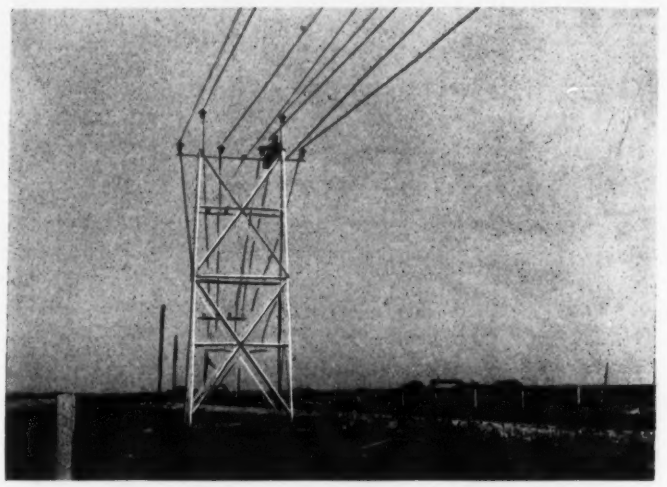


FIG. 10.—STANDARD 40-FT. TOWER.

three-phase power feeder panels, capacity each two 550-kw, 2,300-volt circuits; two three-phase, 5,400-kw step-down transformer panels, 55,000 to 2,300 volts; one 2,400-kw, 5,500 to 2,300-volt step-down, three-phase transformer panel; one three-phase, 15,000-kw, 55,000-volt incoming line; one three-phase, 6,500-kw, 55,000 to 2,300-volt bus sectionalizing panel; one three-phase, 15,000-kw, 55,000-volt incoming line panel; three three-phase, 2,400-kw, 55,000 to 2,300-volt step-down transformer panel; ten two-circuit, 75-amp., single-phase, feeder panels; three two-circuit, 550-kw, 2,300-volt, single-phase feeder panels, with future extensions for 12 additional feeders.

All of the oil switches are arranged in hard pressed brick cells and all operating leads from the switches to the switchboard are run in 1¼-in. enameled iron conduit.

The source of supply for operating the motor-operated and solenoid-operated oil switches consists of 55 cells of chloride accumulators located in the basement of the building. The storage battery panel containing the 500-volt charging rheostat is located on the switchboard gallery about in the center of the main switchboard, where it is convenient for the operator. The low-tension buses are located in pressed brick compartments back of the low-tension switches, each phase being separated by a concrete slab.

The lighting feeders will consist of two-conductor cables, and the three-phase feeders of three-conductor cables run in 3½-in. tile duct from the top of the switch cells through the cableway, which consists of a passageway between the high-tension room and the transformer pockets, to cable bells, then through 3½-in. tile duct to manholes in front of the station to points of distribution. An interesting device used with the lighting feeders is an auxiliary lighting bus, so arranged with disconnecting switches on a marble base located in the cableway, that the lighting feeders from each of the oil switches tie on to the disconnecting switches, which are also connected to the auxiliary bus, and in case any lighting feeder oil switch goes out of commission the load on the particular switch, by means of the disconnecting switches, may be transferred to any other oil switch by means of the bus, making the lighting system entirely flexible. The lighting feeders are also provided with single-phase, motor-operated feeder regulators, each having a secondary wound for 150 amp., 115-volt 10 per cent boost or lower, the regulators being oil-immersed and self-cooled.

The arrangement of the high-tension compartments, transformer pockets and delta connections are similar to those at the

transformer house at Lac du Bonnet. All of the cells for oil switches, lightning arresters and high-tension compartments are provided with asbestos lumber doors.

In the sub-station there are provided six 1,800-kw and nine 800-kw step-down transformers. The transformers are oil and water-cooled, with the same guarantees as to efficiency and regulation as those at the power house.

For direct-current railway and stationary motor work the ultimate capacity of the station will be seven 800-kw synchronous motor-generator sets operating at a speed of 400 r.p.m., with 2,300 volts on the alternating side, 550 to 600 volts on the direct side. The generators may also be operated as shunt-wound generators at 600 volts. With a proper shift of the brushes the direct-current machine may operate as a direct-current motor giving 630 to 700 kw from the synchronous motor operating as a generator. These machines are provided with 17-kw, 125-volt exciters mounted on brackets on the extension of the synchronous motor shafts, and are provided with speed-limiting switches and end play devices.

The manufacturer's guarantees on the motor-generators are: Temperature rise at normal load is not to exceed 35° C., and at 50 per cent overload for two hours not to exceed 55° C. The efficiency of the synchronous motor when used as a motor is 93 per cent at full load, 92 per cent at three-fourths load, and 90 per cent at half load. When the synchronous motor is used as a generator at 100 per cent power factor the full load efficiency is 95 per cent, the three-quarter load efficiency is 94 per cent, and the half load efficiency is 92 per cent. The above efficiencies are ascertained by including the exciter losses. The machines are also guaranteed to carry a 100 per cent overload momentarily without undue sparking. The direct-current generator has an efficiency of 93 per cent at full load and at one and one-half full load. At three-quarter load the efficiency is 91 per cent, while at one-half load it is 88 per cent. The temperature rise of the machine after a 24-hour run at normal load and 575 volts does not exceed 35° C.

The synchronous motor armature leads run from the top of the oil switch cells through 3½-in. tile duct on insulator racks in the basement to the respective machines, the cables being insulated with cambric. The field circuit leads of the motor and the armature and field circuit leads of the exciter are laid in concealed pipes back of the respective motor panels to insulator racks in basement. The generator leads run from the machines on insulator racks in the basement through concealed 2½-in. pipes to the back of their respective panels. The motor-generators are located on the main floor of the building. Four of these sets are at present installed.

The railway feeders run from the back of the panels in concealed 2½-in. pipes to the basement under the main floor through tile duct to manholes in front of the station to the points of distribution. All of the conduit work in the station runs in the concrete floors and brick walls, excepting the lighting circuits of the station, which are not concealed. The lamps and auxiliary station motors are fed from three-phase transformers, 2,300 volts primary, 115-230 volts secondary. There are duplicate oil and water piping systems for the transformers, the former being operated by an induction motor-driven air compressor, the latter by an induction motor-driven centrifugal pump.

The most essential feature in the station construction is the absolute protection to life and apparatus afforded throughout. The cost of the complete plant will amount to approximately $4,000,000.

The officers of the Winnipeg Electric Railway Company are as follows: William Mackenzie, president; William Whyte, vice-president; F. Morton Morse, secretary and treasurer; W. Phillips, manager. Dr. F. S. Pearson, of New York City, is the consulting engineer of the whole work, the details of which were carried out by Mr. L. J. Hirt, as mechanical and hydraulic engineer for Dr. Pearson.

The electrical apparatus was furnished by the Canadian General Electric Company, Limited; the turbines by the S. Morgan-Smith Company; the towers, air compressors and centrifugal pumps by the Canada Foundry Company, Limited; the transmission line copper by the Ansonia Brass & Copper Company, and the insulators by the R. Thomas & Sons Company.

Alternating-Current Magnets.

BY D. L. LINDQUIST.

IN order to afford a comparison between alternating-current and direct-current magnets, a brief review is given of the principles governing direct-current magnets. A direct-current magnet can be made for almost any desired lifting capacity with any desired power consumption. In order to decrease the power consumption, it is only necessary to increase the amount of copper used in the coil, or to increase the section of the iron, or both. As the magnet when working has to pull or hold the weight of its own core, it is self-evident that the increasing of the core will only do good up to a certain limit; after that the magnet pull increases more slowly than the weight of the core increases, and consequently the useful pull decreases. By increasing the copper, or, in other words, increasing the number of turns of wire on the spool, the self-induction is increased which, in its turn, increases the time of energizing. Another thing that prolongs the time of energizing is the induced currents in the solid iron core and yoke.

A direct-current magnet, when being energized, may be considered as a transformer where the winding is the primary and

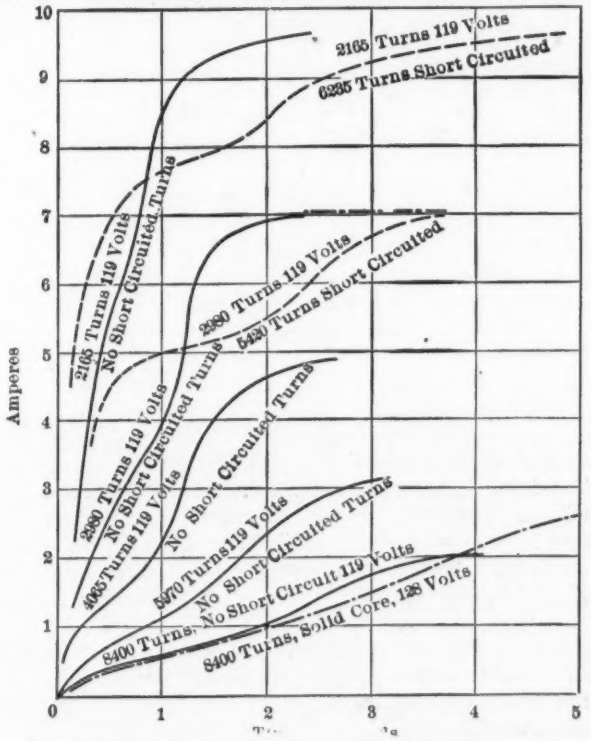


FIG. I.—RETARDATION TEST OF DIRECT-CURRENT MAGNET.

the core, yoke and other solid metal parts, the secondary. The primary current, or the current in the coil, tries to magnetize the core, and the secondary currents oppose the action of the primary current in the coil and always resist any changes in the magnetism. The secondary currents consequently not only retard the action of energizing, but also retard the action of de-energizing.

Now, in order to make a direct-current magnet act quickly not only in lifting but in releasing, it is necessary that the secondary currents be a minimum. The customary way to decrease the secondary currents, and consequently the retarding effect of them, is to mill slots in the solid core and to split up the yoke as much as possible. Where the spool is of metal it should be divided by one slot which cuts the tube and flanges so as to interrupt the metallic circuit around the core. In some cases a very strong retarding action is wanted, and then the core and yoke are made solid and the magnet wire is wound on a heavy brass or copper spool. The retarding and the de-energizing may also be accomplished by placing resistance across the coil. Sometimes the magnet coil is wound in several sections, or with several taps in order to regulate the energizing by optional use of any section or sections, or the retarding by short-circuiting a certain other part of the winding.

This retarding effect is readily shown in the curves of Fig. 1, where the relation between energizing current and time of energizing with and without short-circuited turns is shown. These curves also show that the number of turns in a coil affect the time of energizing; and also the current consumption. The pull being the same in all cases, it can readily be seen from these curves that with 8,400 turns it takes about 4 seconds to energize and lift, while with 2,165 turns it takes only a little over one second. They also show that with 8,400 turns only about 2 amp.

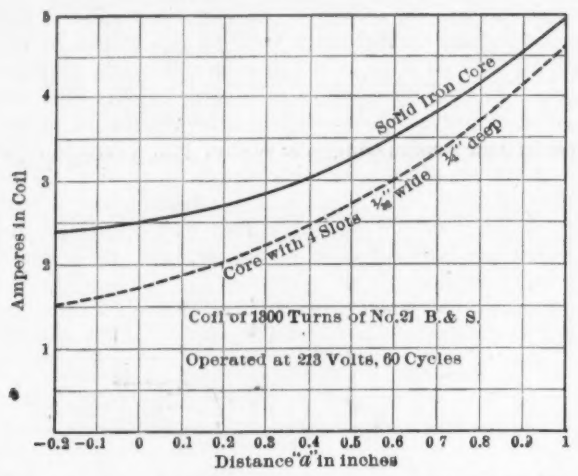

Amperes in Coil
Solid Iron Core
Core with 4 Slots ⅛" wide ¼" deep
Coil of 1800 Turns of No.21 B.& S.
Operated at 213 Volts, 60 Cycles
Distance "a" in inches

FIG. 2.—CURRENT CONSUMPTION OF MAGNET SHOWN IN FIG. 3.

are taken to do the work, while with 2,165 turns it takes about 9.65 amp. The lower curve is plotted for the same magnet with 8,400 turns, but with solid core and 128 volts used for energizing, showing that under these conditions it takes about one second longer to reach the maximum. In general what is saved in current consumption is lost in time, and vice versa.

As alternating current is coming more and more into general use and for many purposes will supplant direct current, a brief description of the general features of magnets for alternating current may be of some interest.

With alternating current the iron part must naturally be subdivided into parts more or less insulated from each other in order to minimize the secondary or eddy currents in the iron. If the magnet is intended for very intermittent work the iron parts may be made solid, but the disadvantages are that the iron will heat very quickly, and also that the magnet takes very much more current than with a laminated core of the same effective iron dimensions. By milling slots in the solid iron parts both the heating and the current are very considerably decreased, as shown by the curves of Fig. 2, which represent tests made on the magnet illustrated in Fig. 3.

Before describing the different types of magnets, the general principles of the theory will be discussed.

In the beginning of this discussion magnetic leakage will not be considered.

Let A = iron section of core,
a = length of air-gap,
n = number of turns in coil,
E = voltage applied,
f = cycles per second, frequency,
λ = field distortion coefficient,
P = pull of magnet in kg.,
W = weight of core,
B = magnetic density in iron core,

We then have from transformer relations:

$$E = 4.44\, f\, n\, B\, A\, 10^{-8} \qquad (1)$$

$$P = \frac{A\, B^2}{8\pi\ 981{,}000}. \qquad (2)$$

For any magnet there is a practical maximum limit for B. For alternating-current magnets the maximum limit of B is determined in general by the heating, and especially so where the magnet is intended for continuous service.

As the heating depends upon the quality of the iron in regard to hysteresis losses, the eddy-current losses, the ventilation and the C^2R losses in the coil, this magnet may be compared to a transformer in almost every respect.

Now, as the pull of a magnet is proportional to B^2 it is from a certain point of view favorable to have B as high as possible. If B is used at its maximum there will be obtained the smallest magnet for a given pull, but not necessarily the most efficient. The maximum magnetic pull exerted by a magnet is limited by the heating in the iron, but not by the heating of the coil, as this can be kept down to any desired temperature by increasing the cross-section of the wire.

Now, let us consider the most efficient magnet for a given pull and stroke; that is, a magnet which takes the least amount of volt-amperes for this given amount of work. There are two things now to be considered—the volt-amperes when the air-gap is maximum and the volt-amperes when the air-gap is at a minimum. The volt-amperes increase almost in proportion to the increase in the air-gap, so long as the air-gap is not too large in relation to the area of the core; that is, when the voltage loss caused by the leakage reactance of the coil itself is not excessive when compared to the impressed e.m.f.

The holding or minimum current practically depends upon the saturation in the iron, and the quality of the same, and also upon the length of the magnetic circuit and the clearance between the core and the yoke.

Now, at first let us consider the saturation curve for the iron as a straight line, then if current in the coil at start $= I$, we have the relation

$$I = C_1 \frac{B}{n}, \qquad (3)$$

where C_1 is a constant. From equations (1) and (3),

$$E\, I = 4.44\, f\, n\, B\, A\, 10^{-8}\, C_1 \frac{B}{n} \qquad (4)$$

$$E\, I = 4.44\, C_1\, f\, A\, B^2\, 10^{-8}. \qquad (5)$$

From equation (2),

$$A\, B^2 = P\, .\, 8\pi\ 981{,}000. \qquad (6)$$

hence,

$$E\, I = C_2\, f\, P, \qquad (7)$$

where C_2 is a constant.

This shows that the volt-amperes under the conditions stated above are directly proportional to the pull and to the cycles, but

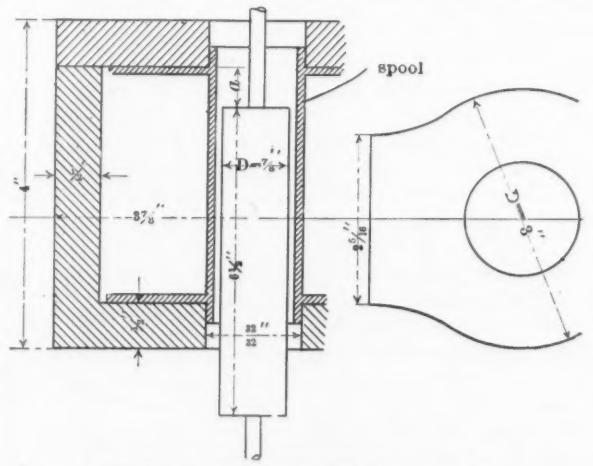


FIG. 3.—ALTERNATING-CURRENT MAGNET.

independent of the area of the plunger. Since the volt-amperes for a given pull are proportional to the cycles and the losses also increase with the cycles, the magnet will have a lower efficiency with an increase in the frequency.

The influence of leakage and field distortion is either to increase the volt-amperes for a given pull or to decrease the effective magnetic pull for a given volt-ampere. Considering the leakage and the field distortion, we have:

$$l = n\, I[f(A)], \qquad (8)$$

where l is the leakage flux and $f(A)$ is a certain function which varies from $f(A) = \sqrt{A}$ to $f(A) = A$.

Electromotive force from the leakage flux in volts is

$$El = 4.44\, f \cdot n^2 I\, [f(A)]\, 10^{-8} \qquad (9)$$

and the total electromotive force is

$$E = 4.44\, f\, n\, 10^{-8} \{ A\, B + n\, I\, [f(A)] \} \qquad (10)$$

$$P = \lambda \frac{A\, B^2}{8\pi\, 981{,}000} \qquad (11)$$

$$I = C_3 \frac{B}{n}, \qquad (12)$$

where C_3 is a constant. Consequently,

$$E = 4.44\, f\, n\, 10^{-8}\, B \{ A + C_3\, [f(A)] \} \qquad (13)$$

From equation (13) we have:

$$B = \frac{E}{4.44\, f\, n\, 10^{-8} \{ A + C_3\, [f(A)] \}} \qquad (14)$$

and from (12),

$$B = \frac{I\, n}{C_3}, \qquad (15)$$

hence,

$$P = \lambda \frac{A\, E\, I}{C_3\, 4.44\, f\, 10^{-8} \{ A + C_3\, [f(A)] \}\, 8\pi\, 981{,}000} \qquad (16)$$

If the design of the magnet is such that $f(A) = A$ and the saturation curve is a straight line, the pull is independent of the core section, A; but if $f(A)$ is nearer $\sqrt{A}$ the magnetic pull will increase slightly with the increase of the section of the core, A. As $f(A)$ varies with the design of the magnet and C_3 varies with the design and also depends upon the quality of the iron, it is impossible to give any universal formula. For this reason $f(A)$ and C_3 must be ascertained for each different magnet. If $f(A) = A$, the tangent to the saturation curve drawn from point o (see Fig. 4) will determine the density, B', to give the maximum ratio between the pull and the volt-amperes.

If, however, $f(A)$ is between A and $\sqrt{A}$ the most advantageous density, B, will be less than B'.

Now, let us consider the shape of the saturation curve. When the position of the core is such as to give a maximum air-gap, the shape of the curve is approximately a straight line unless

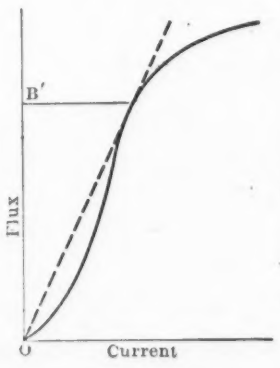


FIG. 4.—SATURATION CURVE.

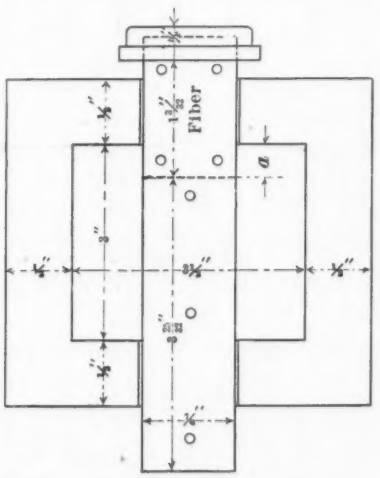


FIG. 5.—MAGNET WITHOUT PERMANENT STOP.

the density is beyond practical limits. And for a magnet such as that shown in Fig. 5 there is always in the magnetic circuit a certain air-gap which naturally tends to straighten the saturation curve, and, in general, for this case the saturation curve may be considered a straight line without introducing any considerable error.

In a single-phase magnet a difficulty experienced is that much noise is caused by the reversal of current and the variation of the value of the magnetic flux, in consequence of which the pull on the core varies from zero to a certain maximum with each alternation.

Let us assume that the core when pulled by magnetic attraction is finally checked by a permanent stop, as shown in Fig. 6. At the time when the magnetic pull is less than the weight of the moving core, the core leaves the stop. Then as soon as the pull increases beyond this value the mass of the core is again lifted with accelerated speed and strikes the stop with a blow.

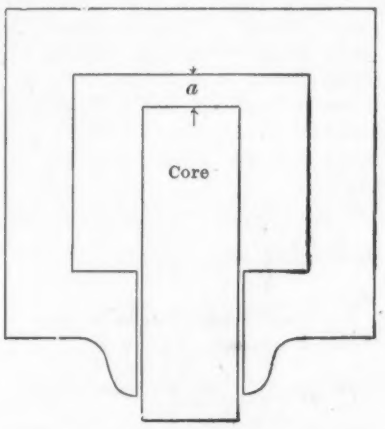


FIG. 6.—MAGNET WITH PERMANENT STOP.

Now, if weight is added to the core, it will naturally drop farther, but it will now cause a harder blow against stop, and produce greater noise. In order to eliminate this noise it is necessary to allow the core to come to a certain mean position; that is, a position in which the average effective pull balances the weight of the core. By the construction shown in Fig. 5 the core has free movement and the noise which would result from hitting is eliminated.

Another cause of noise is the vibration of the core sideways, caused by unequal air-gaps. This inequality is due partly to the fact that there must be some clearance between the core and the yoke to admit of free movement of the core; therefore, the core is pulled to the side having the least air-gap, causing most of the flux to flow on this side. It is, therefore, advisable to design the magnet with an air-gap larger than necessary for free movement and to guide the core centrally by means of some non-magnetic material. There are two ways to diminish the side pull: to increase the area of the air-gap between core or yoke at that point, or to increase the distance between core and yoke, so that the percentage difference of air-gap is small. By increasing the air-gap of course the current consumption is increased.

Unless the laminations are tight noise will be produced by internal vibration, and the greater the saturation the more liability to noise. All loose metal parts should be avoided. Now, as it is practically impossible to make the air-gap the same on the two sides, there is sure to be some side pull, thereby causing noise; this is especially true if the guide is of a metallic material. It is, therefore, advisable to make these guides of some non-metallic substance. Where the alternating-current magnets are used for closing an electric circuit by means of butt contacts, it is, of course, essential to make a permanent contact. For reasons previously mentioned, it is impossible to attach the contact holder rigidly. Therefore, it is necessary to use springs or some other yielding means, and preferably to attach these between the moving core and the contact holder. By this arrangement the core is free to move, and as this movement is very small, even when the magnet is excited from a 25-cycle circuit, the contact pressure caused by the reaction of the spring is practically constant.

It was shown above that it is impossible to get a constant pull with a single coil. It should be mentioned also that the current consumption naturally must be high, due to the construction necessary to prevent noise. A consideration of these facts leads to another form of alternating-current magnet, which is of the polyphase type, and which, as will be shown in a subsequent article, will give a practically constant pull.

A Graphic Method of Determining the Ratio of Speed-Voltage Variation in Shunt Motors.

By A. E. Kennelly.

WHEN a direct-current shunt motor is operated in the ordinary way from direct-current distributing mains, under constant torque, its speed will be uniform so long as the voltage between the mains is uniform. This well-known condition is indicated in Fig. 1, where *m m* are the distributing mains, usually maintaining an e.m.f. of either 500 volts or 230 volts. The armature, *A*, is connected to a mechanical load of constant torque at any particular time considered. The load is, therefore, equivalent to some definite weight, *W*, lifted at constant pulley radius. The shunt coil, *F*, is connected in series with a field rheostat, *H*, which after being once suitably adjusted, is left in a fixed condition, so that the resistance of the shunt-field circuit remains constant.

If now the voltage between the mains *m m* changes, say, *v* per

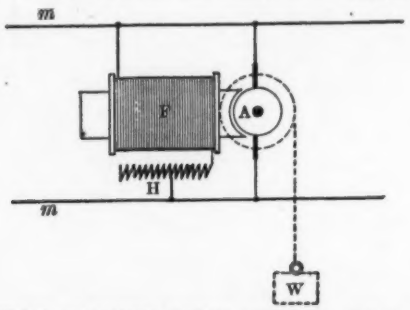


FIG. 1.—DIAGRAM OF SHUNT MOTOR WORKING UNDER CONSTANT TORQUE.

cent, the speed of the motor will thereby be caused to change *s* per cent. The percentage speed change, *s*, will differ, in general, from the percentage voltage change, *v*. The ratio, *s/v*, may be called the *ratio of speed-voltage variation;* or, briefly, the *speed-voltage ratio.*

The numerical value of this ratio, *s/v*, is sometimes of practical importance in shunt-motor operation, when the voltage between the distributing mains is subject to considerable fluctuation, and when the speed of the driven machinery has to be maintained as nearly as possible uniform in spite of that fluctuation.

It is evident that the speed-voltage ratio should be as small as possible. An ideal motor would have $s/v = 0$. Compound winding in a motor may indeed compensate for changes in speed due to change in the load or impressed torque, but will not compensate for changes in main voltage at constant torque.

It is the purpose of this article to show how the speed-voltage ratio may be determined graphically in a very simple manner, when the usual data concerning the magnetic and electric circuits are available.

A preliminary consideration of two ideal simple cases will serve to elucidate the reasoning. Let us first suppose that the magnetic circuit of the motor in Fig. 1 is completely saturated, so that the magnetic flux through the armature will not be appreciably altered by changing the shunt field current *v* per cent, due to a change in main voltage of *v* per cent. Then it is evident that if the *I R* drop of pressure in the armature branch is negligibly small, the motor speed will be exactly proportional to the main voltage; or $s = v$ per cent; so that $s/v = 1$. Thus, if the main voltage increased, say, 2 per cent, the speed of the motor, with saturated field, would likewise increase 2 per cent, and the speed-voltage ratio would be unity.

Let us next suppose, on the contrary, that the magnetic circuit of the motor is completely unsaturated, so that the magnetic flux through the armature increases in direct proportion to the field excitation current; and, therefore, in direct proportion to the main voltage. If the main voltage now increases *v* per cent, the armature flux will also increase in this ratio, and the armature at the same speed will produce *v* per cent more c.e.m.f. Consequently, there will be no change of motor speed, or $s/v = 0$.

Inasmuch as motors operate with a magnetic circuit which is neither completely saturated nor completely unsaturated, but is in some intermediate condition, their speed-voltage ratio will lie between 1 and 0. In exceptional cases where, owing to extra resistance in the armature branch circuit, there is relatively large *I R* drop of pressure in that branch, the *s/v* ratio may become much greater than 1. A sensitive voltage-variation motor-device indicating instrument might be constructed in this way. Ordinarily, however, the *s/v* ratio of shunt motors in practical service appears to range between 0.6 and 0.9, so that if the normal voltage rises or falls, say, 5 per cent, the speed automatically rises or falls from 3 to 4.5 per cent according to the type of motor and to the resistance left in the field rheostat. The smaller the value that the *s/v* ratio can be made without increasing the cost of constructing or operating the motor, the better will be its automatic regulation of speed on mains of fluctuating voltage.

The speed-voltage ratio of a direct-current motor depends upon three quantities:

First. The saturation curve of the motor, or the curve connecting the useful armature flux with the main voltage, or exciting current proportional thereto.

Second. The extent of the impressed main voltage variation.

Third. The amount of *I R* drop of voltage in the armature circuit.

We will first consider the simplest case in which the extent of main voltage variation is very small, and in which the armature *I R* drop is also negligibly small.

Case I. Range of Voltage Very Small. Armature I R Drop Negligible.

Draw as in Fig. 2 the saturation curve of the motor, or adopt its saturation curve as usually supplied with the electrical data of the motor. If the *O X* abscissas are marked off in amperes of field excitation, a scale of main voltage corresponding thereto may be marked off, as indicated in the figure, along the line *O X*, when the resistance of the shunt field branch, including the rheostat, *H*, has been measured. Suppose that the normal main

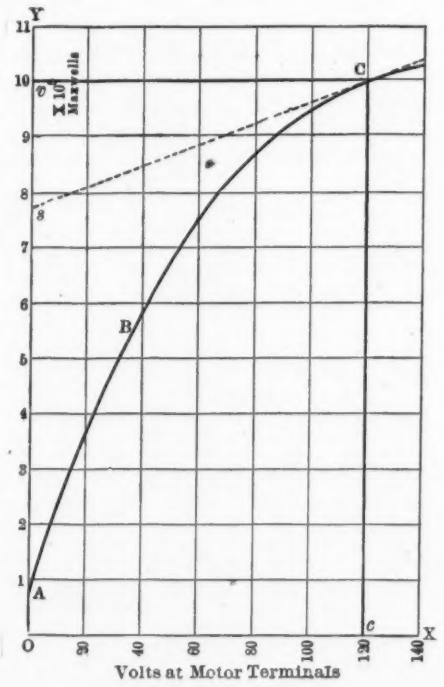


FIG. 2.—VERY SMALL RANGE OF VARIATION IN MAIN VOLTAGE. CASE I.

voltage is 120, at *c*. Then the perpendicular, *c C*, will intersect the saturation curve at *C*, the working point on the curve. The ordinates, *O Y*, are marked off in Fig. 2 as maxwells of magnetic flux through the armature; but this is not necessary. The ordinates may be marked off in volts generated in the armature at any constant speed. At the working point, *C*, draw a tangent, *C s*, to the curve, intersecting the axis of ordinates at *s*. Also draw a straight line, *C v*, from the working point, *C*, parallel to the *O X* axis and intersecting the axis of ordinates at *v*. Then the speed-voltage variation ratio of the motor will be $\frac{O\,s}{O\,v}$; or,

taking $O\,v$ as unit length, it will be numerically equal to the length $O\,s$. In the case of Fig. 2, the s/v ratio is 0.77, so that with negligible $I\,R$ armature drop, and a normal main voltage of 120, a small rise or fall, say, 1 per cent in voltage would produce 0.77 of 1 per cent of rise or fall in speed. This will be true no matter what the relative scales of co-ordinates used in drawing the saturation curve. In other words, any saturation curve of the motor will serve.

As an illustration amounting to a proof, suppose the motor of Figs. 1 and 2 to have $N = 600$ armature face-conductors, and that when 120 volts ($O\,c$) are impressed upon the shunt-field circuit, including the field rheostat, there will be a flux, Φ, of 10×10^8 maxwells, ($O\,v$), passing through the armature. Then the speed, n, revolutions per second will be determined from the relation

$$\Phi_1 N n_1 = 120 \times 10^8 \quad abvolts, \qquad (1)$$

so that $n = 20$ revolutions per second (1,200 r.p.m.).

The tangent to the curve at C indicates that at this point the armature flux varies 1,920 maxwells per volt of small change in main e.m.f. A change of 1 per cent in the main voltage would change the flux by 2,300 maxwells. If the main voltage should rise 1 per cent, the flux, Φ_2, would be 10.023×10^8 maxwells, and the equation:

$$\Phi_2 N n_2 = 121.2 \times 10^8 \quad abvolts, \qquad (2)$$

determines the new speed, n_2, which is $\dfrac{121.2 \times 10^8}{1.0023 \times 6 \times 10^8} =$ 20.154 revolutions per second, an increase of 0.77 per cent, which agrees with the ratio $\dfrac{O\,s}{O\,v}$ of Fig. 2.

Case II. Voltage Variation Unrestricted in Extent. Armature I R Drop Negligible. (*Figs.* 3 *and* 4.)

Take the saturation curve of the motor as before and establish the normal working point, C (Fig. 3), on the curve corresponding to the normal voltage, $O\,c$, taken in this case as 120 volts. Let the main voltage rise to $O\,d$, indicated as 140, or through 20 volts = 16.6 per cent. The point reached on the curve will be D. Connect the points C and D on the curve by the chord $C\,D$, and extend the same to intersect the axis $O\,Y$ at s. Through D, the point attained, draw the straight line, $D\,v$, parallel to $O\,X$, and intersecting $O\,Y$ in v. Then the speed-voltage ratio for the change in main voltage, $O\,c$ to $O\,d$, will be $\dfrac{O\,s}{O\,v}$; or, taking $O\,v$ as of unit length, it will be numerically equal to the length $O\,s$.

As an example and also a demonstration, assume the figures of the last case. The armature flux at 120 volts $= 10 \times 10^8$ maxwells and at 140 volts 10.3×10^8 maxwells. Combining equations (1) and (2) we have $\dfrac{n_2}{n_1} = \dfrac{140}{120} \times \dfrac{10}{10.3} = 1.1327$, an increase of $s = 13.27$ per cent. But the increase in voltage is $v = 16.67$ per cent; so that $s/v = 0.796$, which agrees with Fig. 3; for $\dfrac{O\,s}{O\,v} = \dfrac{82}{103} = 0.796$.

The case of a large drop in main voltage is illustrated in Fig. 4. Here the voltage falls from 120 to 80. The line $C\,D$, carried through the two working points on the saturation curve, $A\,B\,C\,D$, intersects the $O\,Y$ axis at s. The line through D, the point of deviation, drawn parallel to $O\,X$, intersects the $O\,Y$ axis in v. The speed-voltage ratio over the range $c\,d$ is $\dfrac{O\,s}{O\,v} = \dfrac{61}{87} =$ 0.7011. The armature flux at 80 volts is 8.7×10^8 maxwells; so that as before,

$$\frac{n_2}{n_1} = \frac{80}{120} \times \frac{10}{8.7} = 0.76629, \quad \text{or a diminution;}$$

$s = 23.371$ per cent. The diminution in voltage from 120 to 80 is 33.3 per cent. The ratio $s/v = 0.7011$, checking the graphical result.

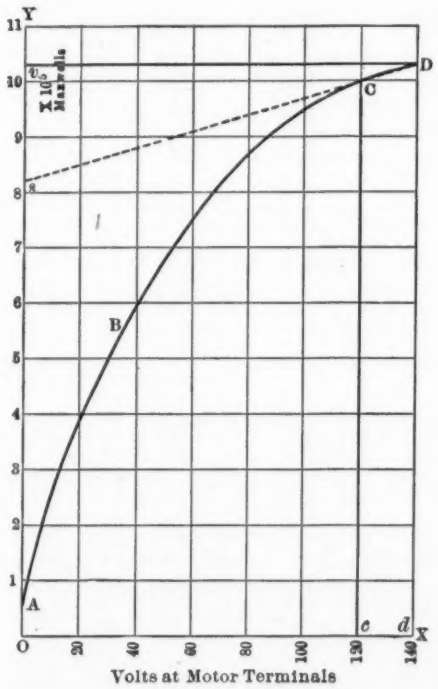


FIG. 3.—RISE OF MAIN VOLTAGE CASE II.

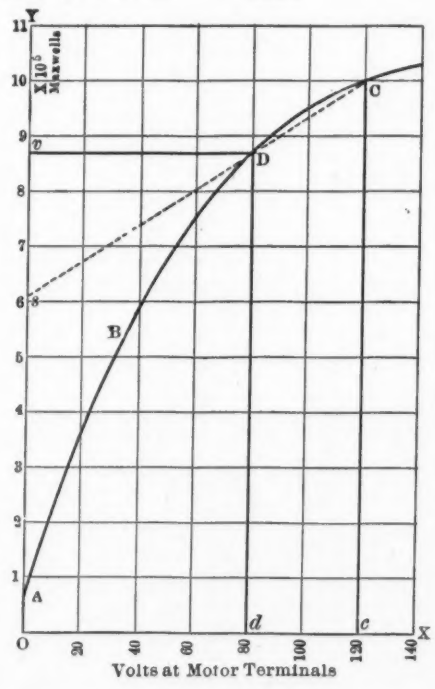


FIG. 4.—FALL OF MAIN VOLTAGE. CASE II.

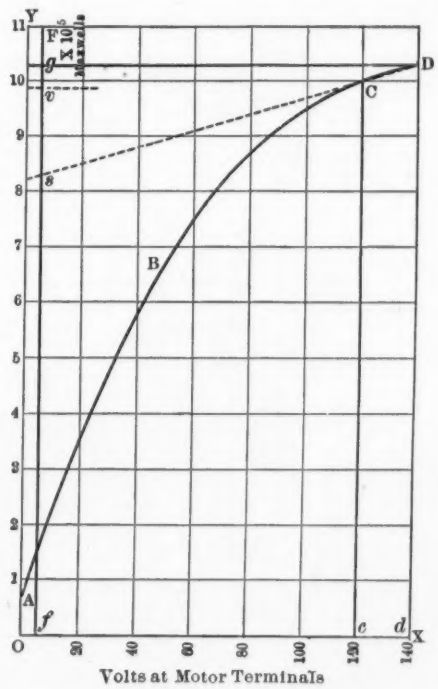


FIG. 5.—RISE OF MAIN VOLTAGE. CASE III

It is evident that as the range of voltage variation diminishes, or the points c and d approach each other on the $O\,X$ axis, the line $C\,D$ joining the corresponding working points on the saturation curve approximates to a tangent line at C, as in the first case considered (Case I).

Case III. Voltage Variation Unrestricted and the Armature I R Drop Also Unrestricted. (*Figs.* 5 *and* 6.)

Mark off, as before, the normal working point, C (Fig. 5), on the saturation curve, $A\,B\,C\,D$, corresponding to the terminal or main voltage, $O\,c$, which is impressed on the shunt-field branch circuit. Let the main voltage rise to $O\,d$. Mark off the working point, D, arrived at. Join the points $C\,D$ by a straight line intersecting the $O\,Y$ axis, as before. Mark off at f along the $O\,X$ axis a voltage equal to the $I\,R$ voltage drop in the armature circuit. In this case, represented by Fig. 5, this $I\,R$ drop is 5 volts. Erect the perpendicular, $f\,F$. Carry the line $D\,g$, from the working point D, arrived at, or the point of deviation, parallel to the $O\,X$ axis and intersecting the line $f\,F$ in g. Lay off on $g\,f$ a length $g\,v$ proportional to the $I\,R$ armature drop with

respect to the normal voltage; so that $\frac{g\,v}{g\,f} = \frac{O\,f}{O\,c}$. Let the line $C\,D$ extended cut the line $f\,F$ at s. Then the speed-voltage ratio will be $\frac{f\,s}{f\,v}$; or will be equal to the length $f\,s$ if $f\,v$ be taken as unity. In the case of Fig. 5, $f\,s = 8.275$ and $f\,v = 9.871$; so that $s/v = \frac{8.275}{9.871} = 0.8383$.

As a check on this result, we have from formulas (1) and (2), taking 5 volts of armature drop in each case,

$$\frac{n_2}{n_1} = \left(\frac{140 - 5}{120 - 5}\right)\frac{10}{10.3} = 1.1398,$$

an increase s of 13.98 per cent. The increase of impressed main voltage is $\frac{20}{120} = v = 16.6$ per cent. The ratio $s/v = 0.8383$, agreeing with the graphic result.

In Fig. 6 the main voltage is indicated as falling from the normal, $O\,c$, of 120, to $O\,d = 80$, a decrease of $v = 33.3$ per cent. The armature $I\,R$ drop, $O\,f = 5$ volts, or 4.175 per cent of normal voltage, $O\,c$. The chord, $C\,D$, extended, intersects the perpendicular, $f\,F$, in s, and $f\,s = 6.2625$ units on the scale of ordinates adopted. The horizontal, $D\,g$, through D, the working point reached, cuts $f\,F$ in g; such that $f\,g = 8.7$. Marking off $g\,v$ as 4.175 per cent of $g\,f$ to correspond to the normal percentage of armature drop, we have $f\,v = 8.3375$. The ratio $\frac{f\,s}{f\,v} = \frac{6.2625}{8.3375} = 0.7511$. The ordinary formula combining (1) and (2) gives

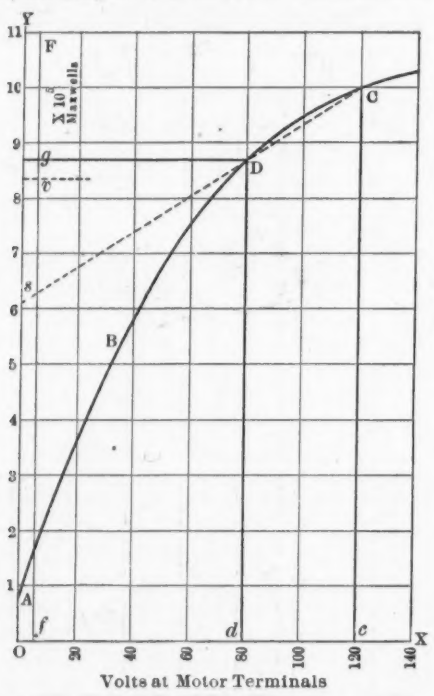


FIG. 6.—FALL OF MAIN VOLTAGE. CASE III.

$$\frac{n_2}{n_1} = \left(\frac{80 - 5}{120 - 5}\right)\frac{10}{8.7} = 0.74963,$$

a diminution s of 25.037 per cent as against a diminution v of 33.3 per cent; so that $s/v = 0.7511$, which checks the graphic result.

It is evident that by making the constant armature drop large enough, with the aid of extra resistance in the armature branch circuit, the speed-voltage ratio might be made theoretically as great as desired. In other words, a small motor like a meter motor, with nearly saturated, or permanent-magnet, field, and a suitable manganin resistance in the armature circuit, loaded with a definite constant torque, might be made to have a speed-voltage ratio of, say, 10; so that each 1 per cent of main voltage variation would produce 10 per cent change in normal speed. In that case the normal armature drop would be 90 per cent of the main voltage. Such a device might furnish a sensitive voltage-variation indicator.

It is also evident that in order to obtain the smallest speed-voltage variation, in cases where a close automatic regulation of motor speed is desired, a motor should be selected which operates low down on its saturation curve, say near B, in Figs. 2 to 6. The field rheostat, H, Fig. 1, should likewise be fixed to include maximum resistance, for the same reason. It would be possible to meet this condition in practice by taking a larger motor than would ordinarily be needed for the work required, and artificially weakening the field of this motor to the desired degree, by including extra resistance in the shunt field circuit, thereby bringing the working point low down on the saturation curve.

Very small variations of main voltage are found by experiment to possess a somewhat larger speed-voltage ratio than corresponds to the regular saturation curve, for the reason that small hysteretic cycles executed at any stage of a saturation curve are known to be flatter than the curve in the vicinity.

It may be noticed that the construction in Cases II and III correspond algebraically to

$$s/v = \frac{\frac{\Delta\,\omega}{\omega}}{\frac{\Delta\,E}{E}}, \qquad (1)$$

where ω is the normal speed of rotation of the motor and E the normal main voltage. $\Delta\,\omega$ is the change in speed due to a considerable change, $\Delta\,E$ in E. The construction in Case I corresponds similarly to

$$s/v = \frac{\frac{d\,\omega}{\omega}}{\frac{d\,E}{E}}, \qquad (2)$$

where $d\,\omega$ is the infinitesimally small change in speed due to a like small change in E.

From this standpoint, the construction of Case I is supplementary to a construction for the increase in voltage of a dynamo due to increase in driving speed published by M. Paul Boucherot.*

The simple speed-voltage ratio of Case I, Fig. 2, also corresponds to what Mr. H. S. Baker has proposed to call the *"percentage of saturation"* of a dynamo machine.†

The simple speed-voltage ratio of formula (2), Case I and Fig. 2, is also connected with the *"saturation-factor"* of a machine in a definite and simple manner. The saturation-factor may be defined as the percentage increase in excitation required at any stage of magnetization in order to generate one per cent increase in armature flux. It may be shown that, referring to Fig. 2, the saturation-factor $= \frac{O\,v}{s\,v}$. Consequently, if the speed-voltage ratio be denoted by r and the saturation-factor by f, we have

$$f = \frac{1}{1 - r} \qquad (3)$$

and

$$r = 1 - \frac{1}{f}. \qquad (4)$$

Thus, for the case represented in Fig. 2, where $r = 0.77$, we have $f = 4.348$, and again a saturation-factor of $f = 3$, say, would correspond to a speed-voltage ratio $r = 0.6667$.

Transactions International Electrical Congress of St. Louis, 1904, Vol. I, p. 671.

†H. S. Baker, "Saturation Expressed in Percent.," *Electrical World*, p. 1037, Vol. XLVI, No. 25, Dec. 16, 1905.

Substation Equipment of the Long Island Railroad.

As supplementary to the outline description of the transmission system of the Long Island Railroad, which appeared in our issue for June 9, we are to give below a brief account of the equipment of the rotary-converter sub-stations which form the connecting link between the transmission and the distribution circuits.

The principal feature of each sub-station is its equipment of rotary converters and transformers. In a single instance, namely, at Hammel, a storage battery was installed as an adjunct to the sub-station machinery. The location and arrangement of each sub-station building is such as to enable the ultimate use of a storage battery should future conditions justify it, and the apparatus is so arranged that if the storage battery should be installed the necessary boosters can occupy the space allotted to one rotary converter. The initial and ultimate equipments of five sub-stations are listed in the table given below, which shows first, the amount of machinery that constitutes the present or initial installation, and second, the ultimate installation that can be accommodated in each of the sub-stations as now constructed.

Station.	Rotary Converters Kw.	Transformers Kw.	Boosters Kw.	A.B F'ders.	D.C. F'ders.
Grand Avenue:					
Present installation	3-1000	9-375	....	2	5
Ultimate capacity.....	5-1500	15-550	....	4	11
East New York:					
Present installation	3-1000	9-375	....	5	6
Ultimate capacity.....	4-1500	12-550	....	12	16
Woodhaven Junction:					
Present installation.....	3-1500	9-550	....	12	10
Ultimate capacity.....	6-1500	18-550	....	18	18
Rockaway Junction:					
Present installation	2-1000	6-375	....	4	6
Ultimate capacity	4-1500	12-550	....	11	16
Hammel:					
Present installation.....	2-1000	6-375	2-162	2	6
Ultimate capacity	5-1500	15-550	2-162	5	13

At Hammel, the initial installation also includes one storage battery of 3,200 ampere-hours capacity at the one-hour rate at 600 volts.

The sub-station equipment also includes two portable sub-stations, each of which consists of a car containing one 1,000-kw rotary converter, three 375-kw transformers, and the necessary blower and switchboard panels, high-tension oil circuit breaker, and connecting leads to the outside circuit breakers.

The sub-station buildings are of a uniform type of construction throughout, excepting at Grand Avenue, where the reduced area of the lot made its adoption impracticable. This type consists of a central section of about 51 ft. span, which is wide enough to accommodate two 1,500-kw rotaries and the necessary transformers. The central space is flanked on each side by a narrow section, that on one side being devoted to high-tension bus-bars and switch gear, while that on the other side contains the low-tension switchboard and operating gallery. These leading features are illustrated in Figs. 1, 2 and 3.

Each sub-station is served by a 16-ton Niles crane, hand-operated from its trolley, thus obviating the usual hanging chains. It spans the central bay and it is available not only for handling the permanent heavy sub-station machinery, but also the apparatus of the portable sub-stations, which (except at Grand Avenue), can be run under it upon a track that enters one of the end bays of the building. (See Fig. 4.) A brief description of the portable sub-stations was given in our issue for November 4, 1905.

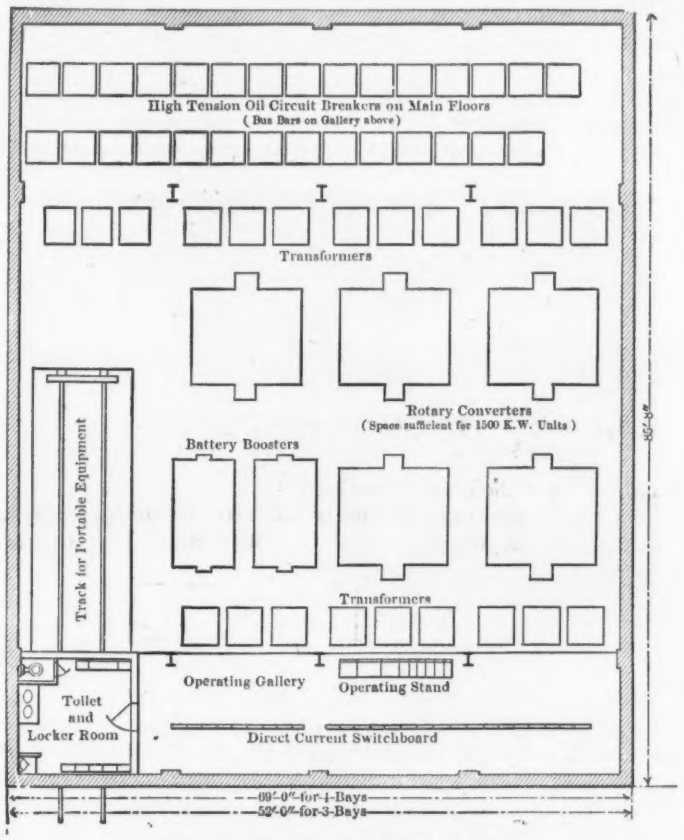


FIG. 2.—PLAN OF TYPICAL SUB-STATION.

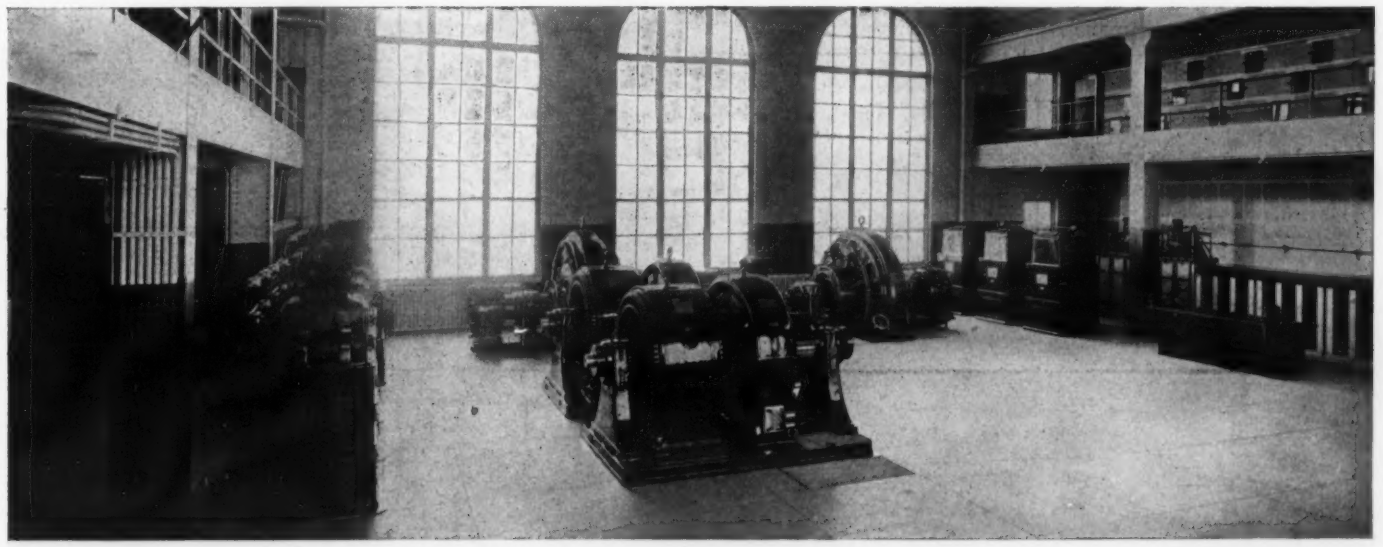


FIG. 1.—INTERIOR VIEW OF HAMMEL SUB-STATION, SHOWING TRANSFORMERS, OIL SWITCHES AND BOOSTERS.

The electrical machinery in the sub-stations is all of Westinghouse manufacture. The rotary converters are of the two-bearing type with field frames divided in a horizontal plane. Each converter is provided with a starting motor, whose frame is mounted upon an extension of the base of the rotary converter. The fields are compound wound with the shunt winding arranged

for self-excitation. The machines are over-compounded, so that if operated as direct-current generators at constant speed, the voltage will rise from 600 volts at no load to 650 volts at full load. The converters are guaranteed to withstand overloads of more than 2½ times the normal load at 600 direct volts without falling out of step, providing the e.m.f. at the alternating end is maintained within 14 per cent of the normal. The transformers used with the converters are of the air-blast type throughout.

As previously outlined, storage batteries are provided at

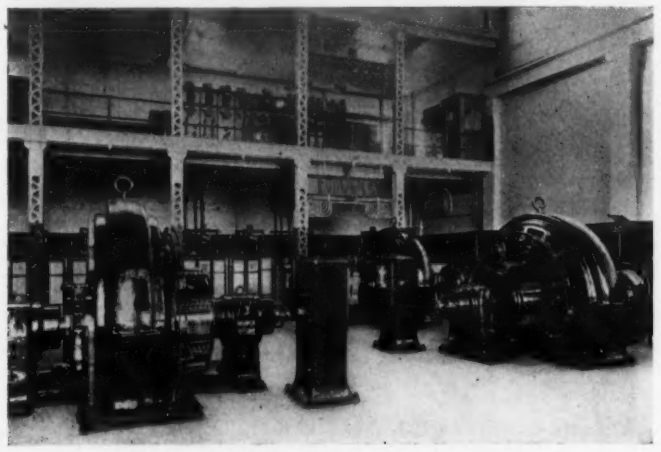


FIG. 3.—GRAND AVENUE SUB-STATION.

Hammel sub-station only, though provision is made in the design of the other sub-stations for the ultimate installation of storage batteries should future conditions appear to require them.

To properly effect the charging and discharging of the battery when used as a regulator for the rotaries, there are two direct-connected, motor-driven, separately-excited boosters, each consisting of one three-phase induction motor and one direct-current generator mounted on a common bedplate. The effectiveness of the battery for this purpose depends upon the quickness with which the intensity of the booster field can be varied and its polarity altered. This is accomplished by means of a small booster-exciter generator driven at a constant speed by an induction motor. The current from the armature of this exciter flows directly through the field coils of the booster. The desired change in the conditions of strength and polarity in the booster field can, therefore, be affected by altering the output

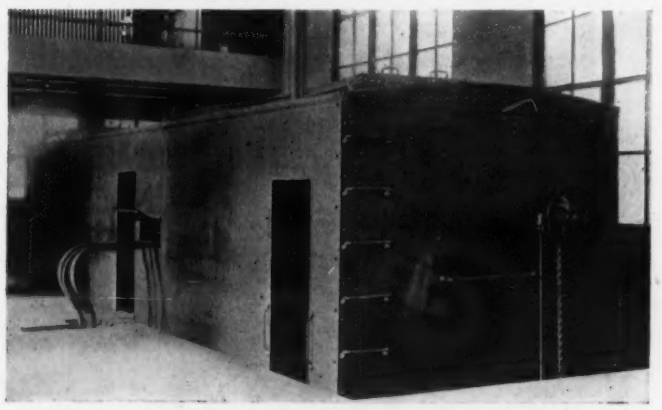


FIG. 4.—PORTABLE SUB-STATION IN SERVICE.

of this little exciter generator and reversing its polarity. This is done by strengthening, weakening, or reversing the current in the field coils of the exciter, which is introduced into the system simply because it can deliver the relatively large current needed for exciting the booster—this amount being much greater than it would be possible to pass through the very sensitive regulator, which can, however, easily and instantly change the small magnetic field excitation of the little exciter. The action of the regulator is shown diagrammatically in Fig. 5, while Fig. 6 is a typical view of the regulator as applied for general work.

The booster is in series with the battery across the 600-volt station bus-bars. From the opposite ends and from the middle point of a section of 100 cells of the storage battery three circuits are led, one of which passes through the field coils of the small exciter to a connection that joins together two piles of carbon disks which are subjected to the pressure of a lever. The outer end of one carbon pile is then connected to one of the wires leading to the positive pole of the 100-cell section of storage battery, and the wiring from the outer end of the other carbon pile is joined up to the negative end of the 100 cells.

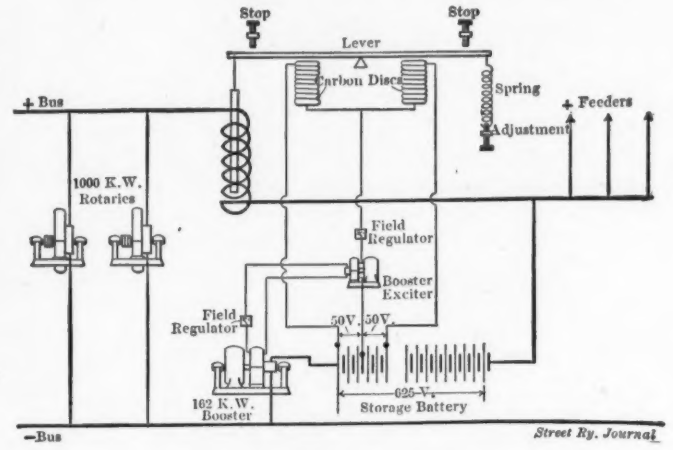


FIG. 5.—BATTERY REGULATOR.

Two circuits are thus formed, each of which includes a separate half of the battery section and one carbon pile, while both have a common connection from the center of the battery section, which passes through the field coils of the little exciter.

The lever which bears upon the tops of the two carbon piles is balanced upon a knife edge, and from one end of it is freely suspended the soft iron core of a solenoid, through the coil of which passes the entire output of the rotary converters. To the other end of the lever is attached a helical spring whose tension may be adjusted by hand to counterbalance the pull of the solenoid at any desired load on the machines. Through

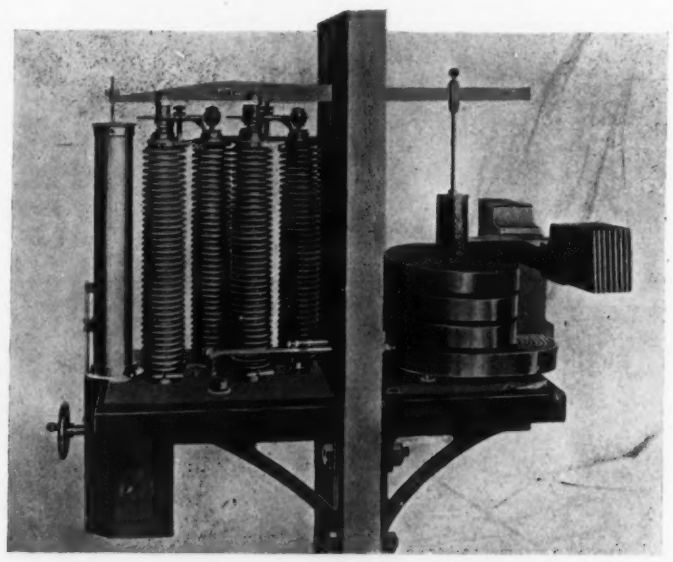


FIG. 6.—CARBON REGULATOR FOR STORAGE BATTERY.

the action of the suspended core of the solenoid slight variations of load above or below this amount will cause changes in pressure on the carbon piles by means of this lever, and will result in wide variations in the contact resistance in the carbon piles. The pile that is compressed through the action of a small increase of current in the solenoid will have its resistance reduced, and more current will flow through it than through the other one upon which the pressure has been simultaneously released.

By means of this regulator mechanism, the strength and the

polarity of the booster-exciter field is caused to respond instantly to the fluctuations in the main power circuit from the rotary converters. The action of the exciter is simply to multiply this effect in the field of the booster itself, which changes its intensity or polarity in exactly the same way, and consequently charges or discharges the battery in almost instantaneous harmony with the changes in load upon the rotary converters.

The switches for manipulating the 12,000-volt current from the transmission system are oil circuit breakers of both the automatic and non-automatic types. All of the switches are automatic, except those used for interconnecting sections of the transfer bus and for connecting two transfer busses to the rotary bus. The non-automatic circuit breakers are electrically controlled from operating galleries, but are not provided with automatic tripping attachments. The automatic circuit breakers, although electrically operated by the manual control of switches on an operating stand, are also automatically opened through relays by the current in the circuit in which the breakers are located.

Direct current for the third-rail and track circuits is distributed from the rotaries to the outgoing circuits through panel switchboards of the standard direct-current type.

The design and construction of the foregoing sub-station system was carried out by Westinghouse, Church, Kerr & Company, engineers for the Long Island Railroad Company, under the direction of George Gibbs, chief engineer of electric traction of the Long Island Railroad Company, subject to the approval of an electrical committee consisting of the chief operating officials of the road, with the president as chairman.

Recent Electrochemical Developments.

DISCHARGES THROUGH GASES.

For a convenient classification of the field of electrochemistry we may distinguish two main groups of processes and apparatus. The first has as object the production of electrical energy from chemical energy and comprises all batteries, primary as well as secondary. The object of the second group is the reverse one, namely the production of chemical effects by electrical means. In this second group we may again distinguish three classes: Electrothermic or electric-furnace processes; electrolytic processes, and electric discharges through gases.

This classification is a convenient one, through it is not very sharp. The first and second classes overlap somewhat; for example, the production of aluminum is both an electrothermic and an electrolytic process. The third class, the production of chemical effects by electric discharges through gases, has achieved industrial importance in recent years only, and in this class are grouped together various processes which, in their chemical character, are essentially different, corresponding to the essential differences in the character of the electric discharges.

The silent discharge is very different from the arc discharge. Correspondingly, the effect of both kinds of discharges through a gas mixture, like air, is very different. The silent discharge results in the change of the oxygen molecules in the air into ozone: $3\ O_2 = 2\ O_3$. The arc discharge results in the dissociating of the nitrogen and oxygen molecules in the air into their atoms with subsequent combination to nitric oxide ($2\ N + 2\ O = 2\ N\ O$) which may then be worked up into nitric acid or nitrates (fertilizers, etc.).

Concerning the mechanism of the formation of ozone, we have very little definite knowledge. It may be that the ultraviolet light of the silent discharge plays an important part in this process. With respect to the "fixation" of atmospheric nitrogen in the form of nitric acid or nitrates with the aid of arc discharges we are now reasonably sure that there is no specific unknown electric effect involved in it, but that the arc simply serves to raise the air to the required high temperature. It is, therefore, essentially an electric-furnace reaction, but one of very special character. It is necessary to heat the air to a high temperature and then to cool it with abrupt quickness, since by slowly cooling the reverse reaction would be enabled to go on, destroying again most of the products formed. It is, therefore, essentially necessary to remove the air through which the arc discharge has been passed as quickly as possible from the sphere of the arc discharge.

Of several recent patents relating to subjects of this class, one, which was granted to J. E. Mitchell and D. Parks, describes an apparatus for arc discharges through air. It contains a stationary electrode and two movable electrodes which make alternately contact with the stationary electrode. Thus an arc is produced alternately at one end and the other electrode. These movable electrodes are geared to pump cylinders which pump air into the electrifying chamber. The machine is claimed to be compact, simple and durable and adapted to operate at a high rate of speed.

The production of ozone for sterilization of water has been repeatedly introduced commercially in Europe, but is making slow progress in this country. On the other hand, it is reported that there are various mills in the West using ozone for bleaching flour. According to a recent patent of S. Leatham, a combination treatment is preferable for bleaching flour or cotton yarn or for sterilizing milk, etc. He passes air successively through two apparatus in one of which it is subjected to the action of a silent electric discharge and in the other to a spark discharge. Air, prepared in this way, is claimed to be very effective for bleaching and sterilizing.

Since it is important to know what kind of an electric discharge is going on in an apparatus, some indicator of the character of the discharge would be useful. In a recent patent of L. Gerard it is proposed to shunt the discharge-gap by a vacuum tube and to subject the rays emitted from the vacuum tube to physical analysis by spectroscopic methods.

New Telephone Patents.

NEW SWITCHBOARD CIRCUITS.

While the Kellogg idea of a divided multiple switchboard has been applied with the magneto system, it is, of course, equally applicable for common battery working. The circuit requirements are, however, different. Mr. J. H. Lendi had patented circuits for such a system. Of course, what he must accomplish is a differentiation at the will of the subscriber between the two-line signals of any line, so that calls may be sent at will to either switchboard. Mr. Lendi accomplishes this by an auxiliary line relay and a push button at the subscriber's station to ground one side of the line. For the main switchboard, therefore, everything works normally. For the auxiliary switchboard, the pushing of this button energizes the differential relay by closing the circuit of one of its windings alone. This relay not only lights its signal, but locks itself for the time being, and shunts out the normal line relay, so that the receiver hook does not affect it. The response of the operator restores everything to normal. The circuit is worked out for the two-wire multiple system of the Kellogg Company, to which the patent is assigned.

SUB-STATION APPLIANCES.

A visible indicator has been brought out by F. R. Lay, of Greenfield, Ind., to indicate which of several telephones of a group has rung. Such a device would be used in an office with several telephones. It contains a pair of magnets for each bell, and these affect a pointer which responds to each successive ring to show which instrument last received a call.

W. E. McCormick, of Chicago, has obtained a patent for a new switch hook, the improvement lying in details of construction. The International Telephone Manufacturing Company has been assigned the patent.

A novel form of receiver holder has been patented by Mr. C. Zimmerman, of Aberdeen, S. Dak. This is a head band with friction clutch for holding a hand type receiver. This clamp is padded to close up the ear to outside sounds, and the other end of the head band has a pad to close the free ear.

PARTY LINE LOCKOUT SYSTEMS.

Four patents have recently been granted for party-line lock out systems. Two of these relate to a system invented jointly by Messrs. N. S. McKinsey and A. R. Nelson, of Susanville, Cal. This is a step-by-step system in which all receivers except those of calling and called stations are shunted, and all bells

are similarly shunted. The synchronous switching mechanisms are spring driven.

W. D. Watkins, of San Jose, Cal., has also patented a step-by-step system. In this the hook switches are locked against upward movement to prevent interference and the bell circuits of non-wanted stations are held open. J. H. Gorden, of Cooper, Tex., has devised a system with a magnetic hook switch lock and an arrangement such that two talking stations engage merely that part of the line between them, only leaving the remainder open for service between stations in either end section.

Letter to the Editors.

Use of Frosted Bulb Lamps.

To the Editors of Electrical World:

Sirs:—We note in the Electrical World of May 26, 1906, page 1082, a communication from Mr. F. W. Willcox regarding our article in the issue of March 17, 1906, page 917, on the effect of frosting on the life of incandescent lamps. Mr. Willcox brings up the point that the life of a clear bulb lamp would be only 53½ per cent of the life values shown for the lamps in enclosing globes in the test if the lamps were, when enclosed in ground-glass globes, brought up to an efficiency which would give the same mean spherical candle-power as frosted bulb lamps. We agree with Mr. Willcox that if this is done the life of the lamp in the enclosing globe will probably be the same as that of a lamp in a frosted bulb. It may be advisable for manufacturers and users to consider whether lamps intended for frosting should not be selected from those which would give lower efficiency with clear bulbs than those which are intended to be used with clear bulbs. In other words, are not commercial frosted lamps being operated at present at a higher efficiency than will give the best results when cost of lamp renewals are figured? The authors will not attempt to say as to this, but it is a point worth thinking about.

At the present time the contention of Mr. Willcox in his letter is of more theoretical than practical value to users because as a matter of fact the conditions in the tests described by the authors, rather than the conditions suggested by Mr. Willcox, are those which exist in practice at the present time. In other words, it is hardly feasible to select higher efficiency lamps for use in enclosing diffusing globes than for use outside of such globes. It may, however, be advisable for the makers to select lamps of lower initial efficiency for frosting. Owing to the larger diffusing surface of the globe as compared to the frosted bulb lamp, it may be possible that even if the actual candle-power with the globe is lower, the ability to see will be equal where the lamps are placed low in the ordinary range of vision. It is not by any means the aim of the writers to discourage the use of frosted bulb lamps, but rather to encourage their use in every way possible, as they should be used in many more locations than they are at present. The aim of the tests was to bring out the commercial facts as far as possible.

Chicago, Ill. J. R. Cravath.
New York, N. Y. V. R. Lansingh.

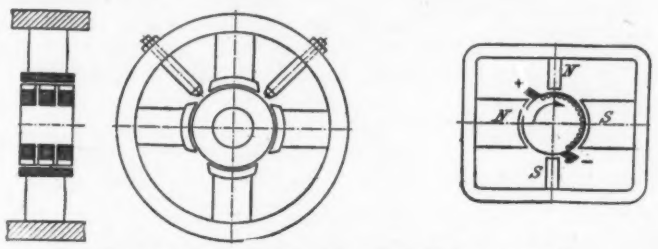
DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Commutation.—Dodd.—A long article, illustrated by diagrams, on "mechanical aids to commutation," the author first defines commutation and describes possible commutation curves. He then explains the purpose and limits of the various devices meant to improve commutation. It is possible to obtain perfect commutation with every machine if the resistance of the contact surface of the brush is infinitely high compared to the resistance of the coil and if we can arrange other forces so that they annul each other. The first condition is obtained in almost every direct-current machine. With carbon brushes and the ordinary style of armature winding if other forces are absent the commutation curve varies very little from a straight line. With copper brushes it may vary considerably from a straight line. In a general way, if we can annul all other forces, the proper place to put high resistance is in the brush contact surface. A high resistance in the armature, either in the coil or in the leads, is a distinct evil. The effect of induction from the outside circuit and the effect of self-induction are then briefly discussed. The effect of shifting the brushes forward is then briefly explained. A great deal can be done toward obtaining sparkless commutation by the use of chord winding on commutation which is very marked. But in order to get the full advantage of chord winding, the reduction in the coil span should be so great that the commutation of the upper coils in a slot must be entirely complete before the commutation of the lower coils shall have begun at the other brush. The author then deals with the effect of field distribution and shows that the following combination would be of great value; a narrow span to the armature coil; design the machine so that a great number of lines enter the armature from the pole so as to make a steep voltage curve directly at the brushes; provide the armature with high resistance leads; a thin brush covering preferably only one bar. In this way it should be possible to obtain all the advantages of high-resistance leads, and a great lead to the brushes without the disadvantage of having to shift the brushes. In all the above devices the limiting conditions are usually very soon reached and none of them will give perfect commutation at all loads and with a fixed position of the brushes. A high brush contact surface is of value, but it will give approximately perfect commutation only when the other forces are low. High resistance leads are of value only when we have self-induction and a great forward lead to the brushes, or its equivalent. Chord winding, even with all refinements, a thin brush, high density in the air-gap at the pole tips, and high resistance in the armature leads will merely have a tendency to straighten the curve at the leading edge. It will not straighten it over its whole extent at all loads. Moreover, high resistance is not altogether desirable. It introduces an undesirable amount of heat which must be dissipated and it lowers the efficiency. The high magnetic density in the air-gap usually means also a high magnetic density in the teeth, causing a considerable armature heating. The thin brush entails a very long commutator, which for high speed machines especially brings in additional mechanical difficulties with what is already a most difficult part of the machine. The only proper way of solving completely the problem of perfect commutation is to eliminate armature self-induction and induction from the outside magnetic circuit. The latter is in most machines induction from the main pole and it is a simple matter to make the distance between the main poles and the chord of the armature winding such that the commutated coil is entirely out of influence of the main poles. The problem of eliminating self-induction is solved by auxiliary poles (interpoles). With auxiliary poles, chord winding is of no special benefit, but rather the reverse. As to the limits of the advantages of auxiliary poles, it is difficult to speak at present with certainty. It appears for all time to make mechanical considerations and temperature rise the limiting factor in dynamo designs. On most machines we have already learned by other means to make these the limits; that is, commutation is not usually the limiting condition. It is only with the more difficult machines that auxiliary poles need at present to be considered; that is, with turbo-generators, alternating-current, direct-current motor-generator sets, variable-speed and variable-voltage machines. The tendency of engine construction is ever toward higher speed and its consequently decreased floor space. We are learning more and more the advantage of ventilation and the greater output of machines which it entails, especially with the higher-speed machines. It may be, therefore, predicted that auxiliary poles will also come into vogue with engine-type machines for the higher

speeds. The degree to which they come in depends on the efficiency of ventilation. Comparatively speaking, however, their use will be limited.—*Elec. Jour.*, June.

Hunting of Direct-Current Machines with Interpoles.—SIEBERT.—An article on the fact that the provision of auxiliary poles may, under certain conditions, cause hunting. The motor with which he experimented is shown diagrammatically in Fig. 1; it



FIGS. 1 AND 2.—HUNTING OF INTERPOLE MACHINES.

was designed for 12.5 hp at 230 volts and for a speed varying between 400 and 1,200 revolutions per minute. The four-pole motor had only two auxiliary poles; this arrangement is permissible if a series winding and only one brush each for the positive and negative pole are chosen; further, by using a sufficient distance between the pole ends, etc., care must be taken that at those places where there are no interpoles, the external field is not distorted to such an extent as to generate obnoxious e.m.f's in the coils short-circuited during commutation. This arrangement results in less cost, less losses in the interpoles, better ventilation and a diminution of the hunting. As long as the brushes were in the central position, or shifted forward (i. e., in the direction of rotation of the armature), there was no hunting whether the machine was loaded or not. If, however, the brushes were shifted backwards, hunting occurred. With a strong main field the oscillations were quickly dampened; when the field was weakened and the speed increased, the oscillations increased. The more the brushes were shifted backwards, the lower was the speed at which hunting started. An increase of the armature current had the same effect. With unexcited interpoles these phenomena were not observed. Besides oscillations of the armature current, the speed and the shunt current also showed oscillations. These phenomena are explained as follows: If the brushes are shifted backwards (Fig. 2), a main pole and an auxiliary pole of opposite polarity act on the armature conductors between two brushes. The e.m.f's generated in the armature conductors, therefore, counterbalance each other to some extent. The effect is the same as though the main field was weakened. If now the speed of the motor is increased by weakening the field by means of the shunt regulator, then the acceleration of the armature requires a greater armature current. This weakens the main field (by the action of the intelpoles) and this results in another increase of speed, acceleration of armature, increase of armature current, and so on. If the main field is comparatively strong, the current and speed will reach a maximum within a few seconds. Since there is no further acceleration, the current and the action of the interpole decrease and the main field is strengthened. This results in an increase of the counter e.m.f. beyond the supply voltage. The machine now acts as generator and is braked. The speed decreases further, and so on. If the main field is sufficiently weakened, the auxiliary pole may get equally strong or stronger, whereby the counter e.m.f. disappears and an e.m.f. is generated in the same direction as the supply voltage and a short-circuit takes place. The oscillations of the shunt current are probably caused by the reaction of the oscillating armature current. The amplitude of the oscillations is determined mainly by the following four points: First, shifting of the brushes backwards from their central position under the interpoles; second, the comparative strengths of the main field and the field of the auxiliary pole; third, the resistance and self-induction of the armature and the interpoles; fourth, the moment of inertia of the armature and of the masses connected with it.—*Elek. Zeit.*, May 31.

Commutator.—LIVINGSTONE.—The conclusion of his illustrated article on the mechanical design of commutators for direct-current generators. The author gives numerical examples illustrating the use of his formulas for the stresses in commutators and describes the best modern types of construction. He points out that the successful running of a commutator depends on the workmanship quite as much as on the design, and only the most experienced workmen should be allowed to build up a commutator.—*Lond. Elec.*, June 1.

Lamps and Lighting.

Nernst Lamps.—HARTMAN.—An article on the temperature of the glowing filament of the Nernst lamp. Early determinations of the same gave values which are now found to be much too high. These determinations were based on the law of radiation from a "black body." To this class of radiators, however, the Nernst glower does not belong; so that if the glower emits selective radiation as compared with the radiation from a black body, its measured "black-body temperature" might be much above its actual temperature. Careful tests by the author with the aid of thermo-elements gave results varying from 1,780° to 1,800° absolute temperature (1,507° to 1,527° C.). That the Nernst glower is far from being a black body, is strikingly emphasized, but its economic superiority over that of a black body is not as great as has been claimed for it.—*Phys. Rev.*, June.

Candle-Power and Watt-Consumption.—LUCAS.—Voit has established the rule that within certain limits the candle-power of incandescent lamps is proportional to the third power of the watts consumed. The present author shows that this result follows from the thermodynamical laws of radiation, if the filament is assumed to behave as a "black body."—*Elek. Zeit.*, May 31.

Power.

Lubrication of Bearings.—MATTICE.—An article in which the author refers to one of the commonest causes of trouble in two-part bearings, which is side binding. This occurs principally in vertical engines and in other machinery where the principal load on the bearing is that due to the dead weight of the rotating part. The bearing boxes are too often bored and scraped to a good fit all around without being cased off to prevent the wedging action near the parting of the boxes, which not only caused a tremendous pressure on the bearings at these points, but prevents the oil from getting in between the shaft and the bearings. A bearing is always much better if cased off so that it will be well clear of the shaft for at least 20 degrees of arc on each side of the center line, and even 30 degrees is not excessive. In the matter of oil grooves also, designers frequently seem loth to sacrifice bearing area. No area, no matter how great, can be sufficient unless properly lubricated. The smaller the amount of oil fed to the bearings, the more it costs. If just enough oil is fed to the bearings to permit of motion without damage, the oil becomes "worn out" by excessive friction. If, on the other hand, an excess of oil is supplied, a less quantity is actually worn out, while the excess can be recovered and used over again. The central gravity system of lubrication, which has come into extensive use in engine installations within the past few years, has resulted in a marked saving in cost of lubrication and the elimination of bearing troubles. An extension of the principle of continuous circulation of oil obtains in the flooded system of lubrication which has come into use in connection with steam turbines. There seems to be a wide misapprehension as to what is a safe temperature. An investigation by the author of the temperature of bearings of a large number of engines of various makes showed that many bearings were running at over 150 degrees, some considerably higher, and in one case a continuous temperature of 180 degrees was found, and in all of these cases the bearings were giving no trouble.—*Elec. Jour.*, June.

Interpole Motors for Industrial Plants.—HIPPLE.—The possibility of varying the speed of motors with auxiliary poles within wide limits makes them specially valuable for machine-tool driving in industrial plants. The author believes that the saving in wiring and power house equipment made possible by the use of the single-voltage power distribution will of itself be a large factor in leading to the general adoption of the system for industrial plants. At the same time the simplicity of the distribution system and the control makes the handling of the motors easy for inexperienced men and insures a minimum amount of trouble and interruption to work.—*Elec. Jour.*, June.

Traction.

Electricity for Canal Operation.—The German Congress has recently granted the funds for the building of the first portion of a large canal network in central Germany. The total cost will be more than $83,000,000. An essential point in the bill is the uniformity of the methods of handling on all canals in Western Germany. In connection with this project the opening of the Teltow Canal (connecting the rivers Spree and Havel south of Berlin) is of special interest, where electricity is used for various purposes, especially for hauling the boats from the banks of the canal, for auxiliary power purposes, for operating cranes, for lighting, etc. Electrical energy will also be furnished to private consumers, and it is expected that the banks of the canal will become the seat of industries. The Government has the right to condemn the property on both sides of the canal to a distance of 1 km. (0.6 mile) from the center of the canal. An article by Block, describing in detail the equipment of the Teltow Canal and profusely illustrated by diagrams, begins in the same issue. —*Elek. Zeit.*, May 31.

London.—An illustrated description of the new electric trains recently put into service on the Metropolitan Railway. They are composed of six coaches of which the two end cars are motor cars. The four centre cars do not carry motors; the two of these which are next to the motor cars are ordinary trailers, but those in the center are fitted with driving gear, so that during the hours of light traffic the six-car train can be divided into two parts, and each three-car train thus formed can be driven from either end. There are eight 200-hp motors per train, all controlled by the multiple-unit system. The third rail is used.—*Lond. Elec.*, June 1.

Electric Locomotives.—An illustrated description of the new electric locomotives on the Metropolitan Railway in London. The weight of each locomotive is 50 tons, distributed equally over the four axles, and the maximum draw-bar pull which they can exert is 20,600 lb. Each of the two trucks is provided with a 300-hp motor.—*Lond. Elec.*, June 1.

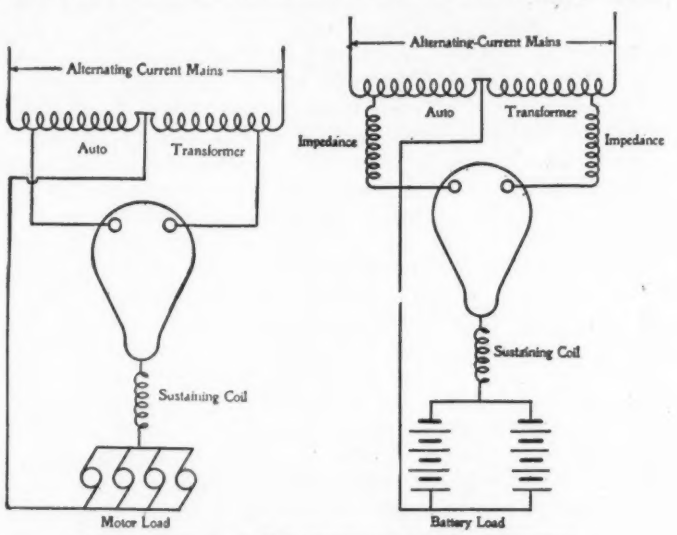
Long-Distance Magnetic Effects from a Trolley Line.—Bauer. —An abstract of a Phys. Soc'y paper. A close inspection of the magnetograms obtained during the past year at the United States Coast and Geodetic Survey Magnetic Observatory, situated at Cheltenham, Maryland, employing the sensitive Echenhazen-Edler variometers, has disclosed the fact that magnetic effects are being photographically registered daily which are to be ascribed to an electric car line 12 to 14 miles distant. This line, proceeding from Washington to Mount Vernon, Va., is a "single trolley" line with defective bonding of the rails. The magnetic element principally affected, viz., the vertical intensity, exhibits during the period of the day (5 a. m. to about one and one-half hours after midnight), when the cars are running, a number of short, more or less periodic waves of fluctuations superimposed upon the normal curve. The average deflection to be ascribed to the electric car effect is about 1/75,000 to 1/150,000 part of the vertical intensity. Up to this time it had been generally supposed that no electric car effects could be detected beyond five miles.—*Phys. Rev.*, June.

Installations, Systems and Appliances.

Regulation in Vapor Converters.—Thomas.—Regulation of a converter is the drop in voltage produced in the delivered direct current by an increase in current from zero to full load, assuming the voltage of the alternating-current supply circuit to be constant. With the Cooper-Hewitt converter we cannot tell what its drop will be without knowing the character of load for which the outfit has been designed, for instance, whether for charging batteries or for running constant-speed motors. The actual drop consists of two parts, first the drop in the bulb, and second, the drop in the auxiliary apparatus. The drop in the bulb, which is due to an increase of current, is nearly zero, being slightly negative; i. e., at a small current there is a certain voltage loss in the bulb, while at a higher current a little less voltage is lost. The effect of the bulb is, therefore just the reverse of that of resistance. If the converter is to be used for operating motors, the arrangement of Fig. 3 is employed, where there is only the ohmic and inductive drop in the autotransformer and in the sustaining coils. Since the sustaining coil is transversed by direct current, this is principally ohmic loss, which may be made insignificant in amount. On the other hand, with the circuits shown in Fig. 4, which is intended for battery charging, a poor regulation or a certain amount of "backing" is obtained by the introduction of an impedance coil. The regulation of the vapor converter has this unique characteristic. While in itself it does not cause a loss in voltage (but on the other hand, a slightly rising voltage) due to an increase in current, yet it enables auxiliary appliances to be used either in the alternating-current circuit or in the direct-current circuit for obtaining any desired characteristics of voltage regulation over a considerable range. It therefore permits the flexible qualities of alternating-current devices, such as impedance coils, "tub" transformers, and the like, to be effectively utilized for the regulation of direct-current circuits. In this way the auxiliary apparatus used in connection with the converter may be designed to give a very small drop for constant potential or an enormously large drop for other service, as may be desired.—*Elec. Jour.*, June.

Wires, Wiring and Conduits.

Electromotive Force Induced in Transmission Circuits.—C. F. Scott.—An article on the calculation of the electromotive force, induced in transmission circuits. With the use of ordinary mathematics only the author describes methods and gives constants for determining the electromotive force of mutual induction and of self-induction in parallel circuits.—*Elec. Jour.*, June.



FIGS. 3 AND 4.—REGULATION OF VAPOR CONVERTERS.

Electrophysics and Magnetism.

Number of Corpuscles in an Atom.—J. J. Thomson.—A paper in which the author uses three very different methods for determining the number of corpuscles in an atom of an elementary substance, all of which lead to the conclusion that this number is of the same order as the atomic weight of the substance. Two of these methods show in addition that the ratio of the number of corpuscles in the atom to the atomic weight of the element is the same for all elements. The evidence is rather indirect and the data are not very numerous, so that further investigation is necessary before we can reach an exact conclusion. The evidence, at present available, seem, however, sufficient to establish the conclusion that the number of corpuscles is not greatly different from the atomic weight.—*Phil. Mag.*, June.

Demonstration of Alternating-Current Phenomena.—Simons.—An illustrated description of an apparatus for demonstrating various alternating-current phenomena and especially properties of transformers.—*Elek. Zeit.*, May 10.

Electrochemistry and Batteries.

Disinfection by Hypochlorites.—Some notes on the new disinfecting plant of the Metropolitan Borough of Poplar. The electrolyte is a mixture of saturated solutions of magnesium chloride and sodium chloride. Hypochlorite solutions containing 4 grams of available chlorine per litre are produced. For use as disinfectant, the solution is diluted. It is used for watering the streets.—*Lond. Elec.*, June 1.

Units, Measurements and Instruments.

Mica Condensers as Standards of Capacity.—Rosa and Grover. —An abstract of a Phys. Soc'y paper, pointing out that the use of mica condensers as standards of capacity is justified by the most

careful examination of their behavior. The capacity is not, however, perfectly constant, and in order to know the capacity at any given time it is necessary to know certain characteristic constants, namely, the temperature coefficient, the influence of frequency and the influence of the potential used. The power factor of the condenser is an indicator of its quality. The best condensers have extremely small, but measurable power factors. The power factor depends both on leakage and absorption. The latter must be small when the power factor is small.—*Phys. Rev.*, June.

Standard Cell.—HULETT.—A paper on mercurous sulphate and the standard cell. The author concludes from his investigation that mercurous sulphate is the most reliable preparation and gives detailed instruction on its preparation and on the preparation of the paste.—*Phys. Rev.*, June.

Troubles with Instruments.—MCTIGHE.—An account of troubles experienced with instruments in central station practice. Proper care must be given to the connections of meters; with shunted instruments the shunts belonging to different instruments should not be interchanged; in instruments in which gravity plays an important part, due care must be taken in mounting the meters, etc.—*Elec. Jour.*, June.

Telegraphy, Telephony and Signals.

Directed Wireless Telegraphy.—The conclusion of the article by Braun, giving a description of his experiments; also a communication by Brown on similar work done by himself.—*Lond. Elec.*, June 1.

Miscellaneous.

Electric Blasting Apparatus.—MAURICE.—A continuation of his illustrated serial on electric blasting apparatus, with special reference to its use in coal mines. In the present installment the author deals with dynamo exploders.—*Lond. Elec.*, June 1.

Electricity for Domestic Service.—KNOWLTON.—An illustrated article on applications of electricity for heating, cooking, driving sewing machines, etc.—*Cassier's Mag.*, June.

Fuel in Blast Furnace.—RICHARDS.—In a continuation of his metallurgical calculations the author discusses the utilization of fuel in the blast furnace with numerous numerical examples.—*Electrochem. and Met. Ind.*, June.

BOOK REVIEWS.

THE MANAGEMENT OF ACCUMULATORS. Ninth Edition. By Sir David Salomons. New York: D. Van Nostrand Company. 174 pages, 36 illustrations. Price, $2.50 net.

This book is an amplified edition of Vol. I, of Sir David Saloman's older work entitled "Electric Light Installations and Management of Accumulators." The author states that it is merely a simple book for the guidance of those who have the care of storage battery installations. He mentions certain of his own experiences with cells of various kinds. Some of his deductions from observed phenomena are hardly in accordance with the accepted ideas of the present time. The usual descriptions of types of plates with their accompanying illustrations, appear. The book itself is well gotten up; the paper, cuts and type are all to be commended.

REINFORCED CONCRETE. A Handbook for Architects, Engineers and Contractors. By F. D. Warren. New York: D. Van Nostrand Company. 271 pages, illustrated. Price, $2.50.

In his preface the author states that the object in preparing this volume was to produce a reference handbook particularly adapted to the wants of architects, engineers and contractors; and that the general form of design is treated rather than one particular or patented system, but the information may be applied to any such systems. The book is divided into four parts, as follows: In Part I a general but concise résumé is given of the subject from a practical standpoint, bringing out some of the difficulties met with in practice and suggesting remedies. Under Part 2 is compiled a series of tests justifying the use of various constants and coefficients used in the preparation of the tables in Part 3, which consists entirely of tables with descriptions thereof and instructions for their use. The final part treats of the design of trussed roofs from a practical standpoint. The author expresses the hope that the volume may tend to do away with the use of some of the empirical formulas and rule-of-thumb methods of designing reinforced concrete structures, and assist in the adoption of a standard and universal system based upon correct fundamental principles.

PHYSICAL CHEMISTRY FOR ELECTRICAL ENGINEERS. By J. Livingston R. Morgan. New York: John Wiley & Sons. 230 pages, illustrated. Price, cloth, $1.50.

The author has prepared in this volume a text-book on the elementary theory of electrochemistry for the study of physicists and electrical engineers. An advantage in the development of the treatise is that it is not tied up with any particular theory or hypothesis. It refers the reader to the experimentally observed facts in almost every case.

The volume is divided into eight chapters, the first of which deals with fundamental principles, the second with the properties of gases, the third with heat energy and its transformation, and the fourth with solutions. Chapters V, VI and VII relate to chemical mechanics, equilibrium in electrolytes and electrochemistry, respectively. The last chapter contains general problems for the student. There is room for a missing index of subjects. The author is a physical chemist and writes from the standpoint of that branch of science. He brings with him the tools of his guild. It is a pity to see the symbol π used for electromotive force in a book designed for electrical engineers; but of such is the symbolism of electrochemistry and the marked derivation from engineering practice ought to be eradicated by mutual agreement in the near future. The book is clear, precise and up-to-date. It will be welcomed by electrical engineers studying the theory of electrochemistry.

BOOKS RECEIVED.

DIE AKKUMULATOREN. Vol. VI. By Dr. L. Lucas. Hannover: Dr. Max Janecke. 120 pages, 89 illustrations. Price, 4.40 marks.

NOTES ON ELECTROCHEMISTRY. By F. G. Wiechmann. New York: McGraw Publishing Company. 145 pages. Price, $2.00 net.

DIE ELEKTROLYSE GESCHMOLZENER SALZE. Dritter Teil: Elektromotorische Kräfte. By Richard Lorenz. Halle: Wilhelm Knapp. 322 pages, 75 illustrations. Price, 10 marks.

PRACTICAL TALKS ON ELECTRICITY. Part I. Principles and Construction of Dynamos and Switchboards. By William Baxter, Jr. Chicago: The Engineer Publishing Company. 362 pages, 233 illustrations. Price, $2.50.

Electric Illumination on Chesapeake & Ohio Trains.

On the Chesapeake & Ohio railway practically the entire passenger equipment, including baggage and mail cars, is lighted by electricity. This railroad has been carrying electric lighted cars for the past 14 years and at the present time they have some 260 cars equipped with incandescent lamps. During this time the Silvey Storage Battery System has been used in furnishing the current to the various cars in use on the railroad.

Each car is an independent unit carrying a complete storage battery equipment which furnishes current at 24 volts. This low voltage permits the use of lamps having short heavy filaments, and the drop in potential in 12 storage cells when connected in series is so slight as to be negligible in this particular class of work. The use of such a low voltage also very greatly reduces the liability of short circuits throughout the system, and in actual practice it is not necessary to use copper wire larger than No. 4 as main distributors. Since the length of a coach is not very great, the cost of additional copper wire is insignificant.

All the batteries are removed from the cars for recharging, and along the C. & O. railroad three charging stations have been established at Covington and Louisville, Ky., and Richmond, Va. A sufficient number of extra sets of batteries are always kept on hand at each of the above stations so that freshly charged sets can be supplied to the various trains whenever the batter-

ies may be required. When the train pulls in, a special truck is run up along side of the coaches to the carboxes, which are usually suspended beneath the center of each car. Car box rollers are so placed that when the trays containing the storage batteries are disconnected, they can easily be drawn out onto the truck, which is also provided with rollers across its surface. The various coaches of a train are filled with fresh batteries in an almost incredibly short length of time. This system is the essence of simplicity, as on the trains there are no dynamos, regulating devices or other moving parts to be contended with while the train is in service. All the trays are numbered and a careful record is kept so that no mistakes will be made as to just when the battery will need to be removed for recharging.

FIG. 1.—VIEW OF INTERIOR OF A DINING CAR.

Storage batteries having a capacity of 350 ampere-hours at 8-hour discharge rates are used, and the 12 cells are placed in two trays containing six cells each. The hard-rubber jars measure about 6½ in. wide by 12½ in. long and 11¾ in. high. The elements are so placed in the jars, trays and car boxes as to have the 12-in. dimension of the plate in the same line as the direction of motion of the train; thus there is no tendency for the plates to press against one another, or for the jars to do likewise when the train receives a severe shaking due to coupling on additional coaches, etc.

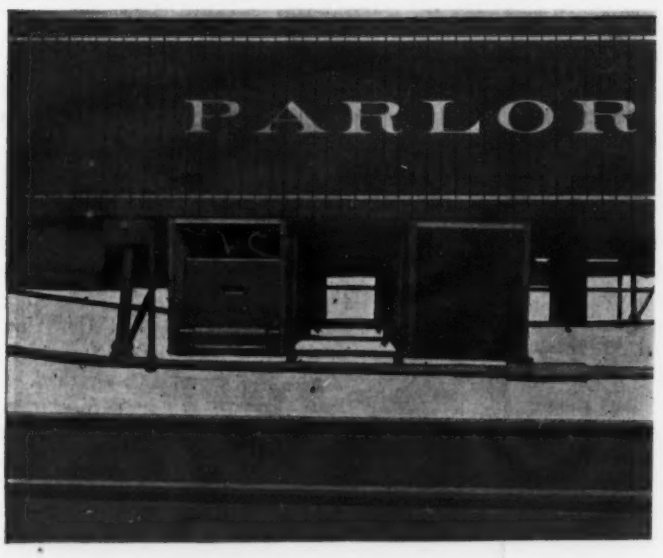


FIG. 2.—BATTERY BOXES UNDERNEATH CAR.

In many of the dining cars and Pullmans as many as 80 lamps are now placed in a single car, and this required increased battery capacity. To meet this requirement additional sets of cells have been placed in parallels across the line so that in certain cases as many as three sets are placed beneath a single car. This gives a total capacity of 1,050 ampere-hours at 24 volts. Cars equipped in this manner are expected to make a run of 2,000 miles on one charge of the batteries. Most of the express and baggage cars carry about 10 16-cp, high-efficiency, 2½-watt lamps, and one single set of cells will supply enough energy to run them for 21 hours on one charge.

Fig. 1 is an interior view of a dining car, which shows the location of the lamps. Fig. 2 shows the arrangement of the car boxes as placed beneath a parlor car. One of the boxes is open and the front roller is plainly visible beneath the tray. Fig. 3 shows the battery truck ready to be unloaded, and Fig. 4 is an interior view of one of the battery charging stations. Each section of the charging table is provided with a rheostat so that the current flowing to each particular set of cells can be carefully regulated. An ammeter is mounted on a small portable truck, and the connections are such that the ammeter can be easily inserted in any particular circuit so that the attendant can rapidly pass down the length of the room and ascertain the amount of current flowing into each set of cells. Fig. 5 is a sectional view of a Silvey storage battery having armored type plates. This battery is particularly adapted to railway train lighting work since the plates are designed to stand all kinds of rough usage without loss of active material, and consequent loss in capacity.

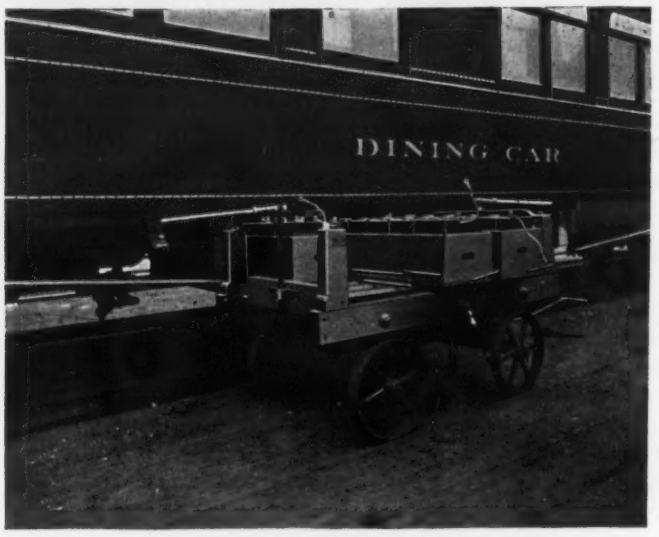


FIG. 3.—BATTERY ON TRUCK.

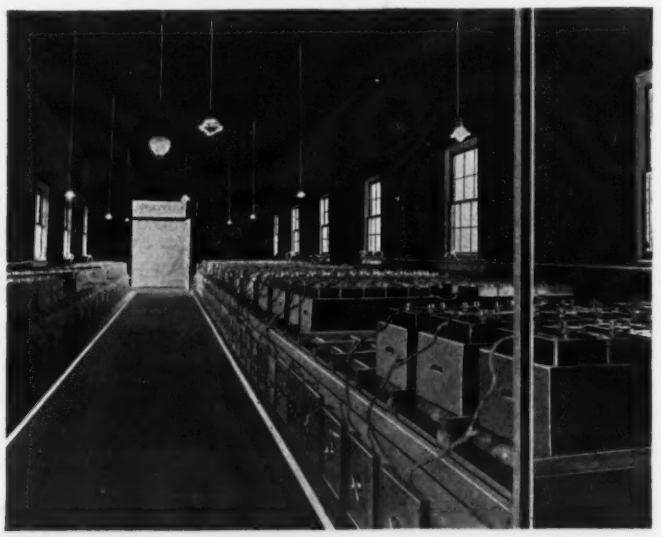


FIG. 4.—VIEW OF INTERIOR OF BATTERY-CHARGING STATION.

The grid is made in two parts, into each of which is forced thin perforated sheet lead so that each half of the grid contains a large number of small perforated pockets. These pockets are then filled with active material, and the two halves of the plate closed and held securely together by means of a large number of lead rivets. The electrolyte can circulate very freely through the perforations, but at the same time the active material is held

securely in place so that there is almost no shedding from plates of this type. The plates are very rigid since the grid work is built up from lead containing a considerable per cent of antimony. This, combined with the efficient separators used, effectually prevents buckling of plates and moreover there is no tendency to buckle under the highest discharge rates since all parts of the plates are carefully balanced. These cells are designed to withstand very high discharge rates, and a long and elaborate series of tests was carried out which proved conclusively that the cells suffered no material loss of capacity when they were subjected to rapid discharges at excessively high rates. This ability to stand up well is in great measure due to the fact that the active material is in immediate contact with the grid since the individual plates can be repaired and new active material can be inserted by driving out the lead rivets and separating the two halves of the plates.

In place of the small hard rubber cover or elaborate covering case surrounding the individual cell which is used to prevent slopping of the electrolyte, a small splasher is placed on top of the plates, which resembles in appearance the criss-cross work placed in egg crates. These small pockets effectually prevent the formation of waves across the surface of the electrolyte. Since there is no covering other than the splasher it is possible to inspect the individual cells when they are removed from the train. The specific gravity of the electrolyte can be easily obtained and fresh electrolyte added to make up for evaporation without undue loss of time in removing troublesome coverings. In Fig. 5 this splasher has been removed in order to more clearly illustrate the construction of the elements.

The question naturally arises as to whether or not it is a profitable investment to maintain an elaborate equipment similar to the above in order to furnish current for lighting the cars by electricity. The Chesapeake & Ohio Company has kept very complete and accurate reports as to the cost of operating and maintaining its storage battery equipment throughout the 14 years. A summation of all these reports proves conclusively that it has been lighting its trains by electricity at just one-third the cost of Pintsch gas or oil lamps. This statement is further

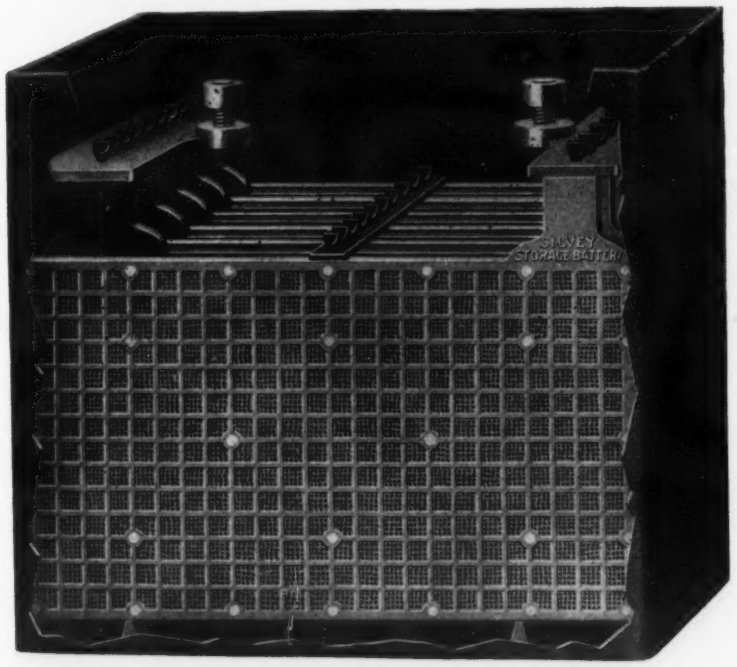


FIG. 5.—BATTERY PLATES.

verified by a report of a committee appointed by one of the prominent railway associations to investigate the cost of the various systems of lighting railway cars in the United States. It is equally true, however, that this statement would not hold good were it not for the fact that practically the entire passenger equipment of the railroad is lighted by means of current furnished by storage batteries, so that on railroads using this system, but having a lesser number of cars in service which are equipped with electric lamps, the relative saving over Pintsch gas or oil is not quite so great.

A Convertible Telephone System.

The International Telephone Manufacturing Company, of Chicago, recently installed for the Macon County Telephone Company, of Decatur, Ill., a "growing-exchange" lamp signal magneto multiple switchboard, views of which are shown herewith. This system, which is convertible into a central energy system at any time, has been designed especially for the use of exchanges where companies are required to re-equip their central office to provide for the constantly increasing demands, and where they are not in position to rebuild for complete central energy at one time. The system is so constructed that it may be used in connection with common return or grounded line construction, and with the old-style individual generator call local battery instruments, and at any time changed to a full central energy equipment without discarding any of the central office equipment of their make installed.

The operating room is equipped with a main switchboard, chief operator's desk and a tollboard. The switchboard consists of four sections of three operators' positions each. The exchange line equipments are distributed with 120 and 130, respectively, in each alternate position, and with 50 self-restoring drop signals for farmer line work in the first annex position.

The board is built with a multiple jack capacity for 4,800 lines. The frame is constructed in sections, arranged for three operators' positions each. Each section is subdivided with eight panels

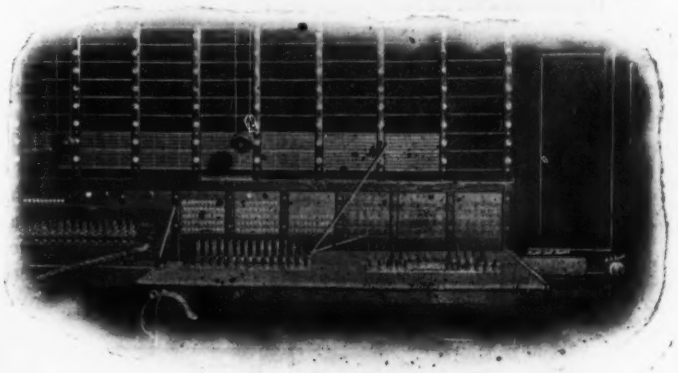


FIG. I.—SECTION OF BOARD.

for the multiple-jack space, and with nine panels for the line equipment space, arranged three panels to each position.

The plugboard is drilled for two supervisory clearing-out signals for each pair of cords. In the present equipment for magneto call service, only one clearing-out signal is installed, but all provision is made so that when the system is changed to central energy, the necessary apparatus may be installed for double supervision. On the key shelves are mounted the vertical type combination listening and two-party selective ringing keys.

Fig. 1 shows the face of the first section. The first position contains the necessary multiple jacks for serving as an annex to the second position containing the first exchange lines. The annex position is also equipped with 50 high-wound bridging non-inductive tubular self-restoring drop and corresponding answering jacks for magneto call rural party lines.

The plugs are of such size as to enable inserting two or more in adjoining multiple jacks which are built on ⅜-in. centers. The plug is provided with a loose sleeve to prevent kinking the connecting cord when the operator turns the plug, as is customary while making a connection. With this system the regular two-conductor connecting plugs and cords are used. The drop restoring device is mounted in the path of the plug and supported on a German silver compensating spring, which insures a positive restoring of the drop at all times, even after the parts have become worn from long-continued usage.

The equipment and wiring is so designed and arranged that the line signals respond to a very slight turn of the subscriber's telephone generator in the old instruments now in use, and so that when the instruments are replaced with central energy telephones the same equipment throughout can be used by simply changing the connection on the relays already provided, and operate as a regular central energy equipment.

The German silver contact springs of the line relays are more than two and one-half inches in length from the contact to the support, giving ample space for a wide and reliable break in the contacts. Each position of the board is provided with an operator's set, including a line pilot, clearing-out pilot and the necessary order wire circuit to the tollboard.

Multiple jacks, in multiple with the answering jacks, are

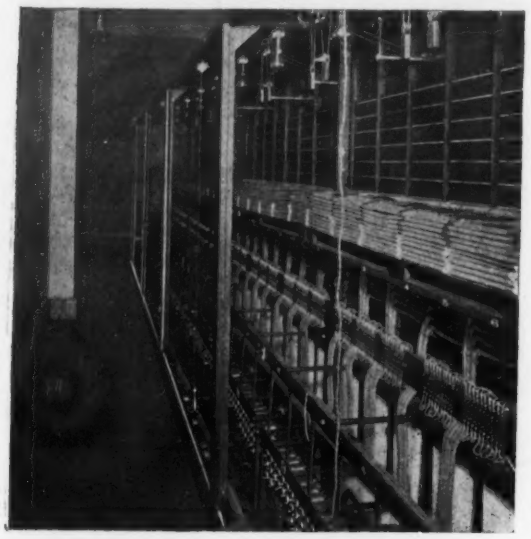


FIG. 2.—REAR VIEW OF SWITCHBOARD.

mounted in each six panels of the eight panel sections, enabling each operator to make connection with any subscriber's line without reaching beyond the three-quarter section in which the call is received, making the reach only two-thirds of the adjoining positions. The line lamp jacks are built in conjunction with the associate answering jack. The lamps are supported in a spring collet brass socket, provided with an opalescent disc. The socket with lamp may be easily removed from the front of the board. The lamp jack springs are so constructed that the lamp

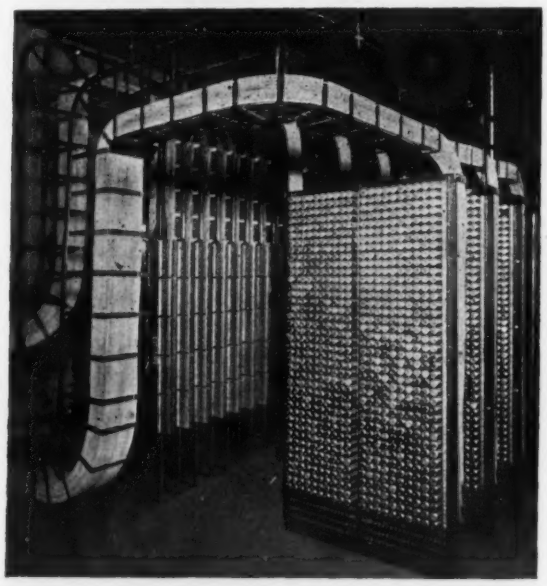


FIG. 3.—TERMINAL ROOM, DECATUR EXCHANGE.

can be inserted only so the terminals will make proper contact with the jack springs.

The clearing-out lamp and also the pilot lamps are so constructed that they may readily be removed from the front of the board, facilitating the testing or changing of lamps in case of defective signals.

The chief operator's desk is of the cordless type, to allow all available space on the desk for clerical work. In the top cabinet is mounted a lamp, connected with the line pilot circuit, and one with the clearing-out pilot circuit of each operator's position on the main board. The cabinet also contains a special listening-in key for each operator's set. To signal an operator, the proper key lever is raised. When the key lever is placed in a downward position, the chief operator's set is connected with the main board operator's set. The circuit is so arranged that the main board operators cannot notice when the chief operator listens in.

Fig. 2 shows the rear view of the switchboard. The arrangement of the working parts of the switchboard apparatus is such that any detailed part may be readily inspected and tested. The frame is provided with a special iron run for the cables. Immediately below the cable run are mounted the clearing-out signal relays with ample space for the supervisory relays when the system is changed to central energy. The cord terminal strips are provided with cord clips and so mounted that the cords may be tested readily or conveniently replaced. The back of the frame is provided with paneled sliding doors, to properly close the board.

For maintaining the lamp signals and operating the relays, operators' transmitters, etc., the system is provided with a storage battery plant and regular power equipment. The charging machine is of sufficient size to operate the exchange when completed to its ultimate capacity, and is built to operate from a 110-volt, direct-current lighting circuit. The motor and dynamo of the charging set are connected by a flexible insulated shaft, giving them the appearance of a tandem machine. The dynamo end is of a necessary capacity to provide sufficient current at a suitable potential to meet the maximum demands of the storage batteries when completed to supply the ultimate capacity of the switchboard when operated as a central energy system. The charging machine runs very quietly and without undue heating. The power plant is also provided with a Roth dynamotor, built to operate from a 110-volt, direct-current lighting circuit, with a secondary output of 100 volts alternating. There was also furnished an auxiliary ringing machine, built to operate from a 24-volt storage battery plant, having a secondary potential of 100 volts alternating.

Fig. 3 shows the relay rack and distributing frames. The distributing frame is a combination main and intermediate rack. The line side is provided with 1,300 pair carbon block lightning arresters and Kaisling self-soldering heat coil protectors. The distribution of the lines is done with flame-proof jumper wire. The cable work between the relay rack, distributing boards and the main switchboard, is carried on special overhead iron cable chutes, and is connected in a neat and substantial manner.

This system thoroughly demonstrates the convertible telephone system, and places the independent companies in position to begin re-equipping their exchanges upon a permanent basis to meet future requirements of their telephone service.

Hawthorne Works of the Western Electric Company.

The Western Electric Company has recently completed at Chicago six groups of buildings, designated as the "Hawthorne Shops," which are being devoted to the manufacture of direct and alternating-current motors and generators, and of telephone and power cables and rubber in the various forms in which it is used for telephone service. The entire plant covers approximately 1,000,000 sq. ft. of floor space and is located on a tract of land of 110 acres.

The foundry is a brick and steel structure, having a tile roof, and is 400 by 176 ft. in floor area, and 75 ft. in height at its highest point. The machine shop is 860 ft. long and 150 ft. wide, and is of the same type of construction as the foundry, except the roof, which is of iron and tarred roof construction. A view of the interior of the machine shop is shown herewith. There are three bays: the center one, 76 ft. wide, is devoted to the manufacture of generators and motors. The north bay, 48 ft. wide, contains such machine tools as are required in the manufacture of small types of machines. In this bay is located the testing department. The south bay has two floors; the upper one being devoted to the manufacture of small field coils and the winding of small armatures. It also contains the small detail and finishing departments. The lower floor contains the commutator and large detail departments, stock rooms and general

shop offices, including that of the shipping department. The lighting is obtained from overhead skylights and side windows. Over the main bay are located two 30-ton cranes, and over the north bay six 20-ton cranes. The entire plant is equipped with a system of industrial railways.

Entering the cable plant from the south is a railway track connecting the receiving department, which covers 15,000 sq. ft., at which the raw material is received. Adjacent to this are the insulating and wire twisting departments, covering 22,500 sq. ft., and from which the material passes into the cable twisting room, covering the same area. From here the cable passes into ovens, covering an area of 10,000 sq. ft., and is finally delivered through small openings in the wall to the pressroom, where the lead sheath is applied. This room is 360 by 100 ft. At the south end is located a storage pit for lead, in which under normal conditions is stored 4,000,000 lbs. Immediately adjoining this section is a room 100 by 50 ft., in which is a battery of six impregnating tanks, used in the insulating of power cables made in another adjoining room, covering 15,000 sq. ft. In addition to these departments, there are the testing and shipping sections, covering an area 440 by 50 ft. There are in process of construction and almost completed buildings which will increase the capacity of the present plant by over 100 per cent.

VIEW OF INTERIOR OF MACHINE SHOP.

The rubber plant forms an L to the cable plant. It has the same railroad connection as the cable plant, and is divided into four sections: the compound mixing, grinding and vulcanizing, sawing and finishing and shipping rooms; all covering an area of 40,000 sq. ft. A portion of this plant is two stories high, the second floor being devoted to the process of drying crude rubber. The buildings of the cable and rubber plants are identical in that they are of brick and steel construction—a special feature being a saw-tooth roof construction, so built that the windows face the north. This type of roof is used entirely in this section of the plant, except in the pressroom of the cable shops, where crane service is furnished by one 20-ton and one 5-ton crane, and in that portion of the rubber plant having two stories.

All of the machinery in the entire plant is electrically driven, an individual drive system being employed except in a few cases. The main machine shop and cable plant contains many variable-speed motors which are operated from a three-wire system. A compensator, or voltage balancer, located in each of these buildings, is of sufficient capacity to carry the unbalanced load resulting from the variable-speed motor load. The voltage balancer consists of two 115-volt machines connected in series directly across the mains, with the neutral wire connected between them. The machines are compound wound, the series field coils being connected in the neutral wire.

The various buildings are connected with the power house by a system of well-lighted and ventilated tunnels in which are located the telephone, lighting and power cables, and pipes for the drinking, city and house water, compressed air, live and exhaust steam, vacuum and trap returns, roof drain and hydraulic elevators. These tunnels have a uniform height of 7 ft., and vary in width from 4 to 10 ft.

Connecting with the tunnel leading to the machine shop is a system of concrete trenches surrounding the iron plates of the testing floor. Within these trenches are cables leading into junction points at which are available for testing purposes all voltages from 30 to 550 volts, both direct current and alternating current of 25 and 60 cycles.

The yard and building illumination consists of arc lamps, two in series on 220 volts, and incandescent lamps for local lighting. The generating equipment consists of four Western Electric direct-current generators, rated at 300, 500, 1,000 and 1,200 kw, respectively. The generators operate normally at 230 volts, but the main switchboard is so arranged that the two smaller units may be operated in series so that 550 volts may be available for testing purposes, the shunt field coils being of sufficient capacity to permit of an increase in the terminal voltage of the machines.

Universal Incandescent Lamp Holder.

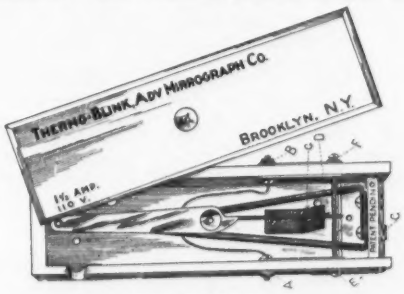
The accompanying illustration shows a lamp holder which has been designed to overcome the defects existing in the drop-cord method of using electric lamps. The holder allows the lamp to be swung in a complete circle eight feet in diameter, to be raised and lowered through a distance of three feet, and twisted and turned to any conceivable angle. Automatic friction clamps at

UNIVERSAL LAMP HOLDER.

all joints enable the lamp to be moved into any position and to stay where placed. This lamp holder is made by the Gail-Webb Manufacturing Company, 6 Lock Street, Buffalo, N. Y.

Motorless Sign Flasher.

The Advertising Mirrorgraph Company, of Brooklyn, maker of "thermo-flashers," has recently placed on the market an in-



SIGN FLASHER.

expensive motorless flasher, illustrated in the accompanying illustration. This flasher is unaffected by exterior temperature changes and only operative when the current is applied. This result is obtained by heating alternately two opposed legs of the same expanding material which in turn throws a lever from one contact to the other. The breaking is done with a snap due to a retarder, and the contacts being platinum, the life of such an apparatus is almost indefinite.

The Steam Railroad Convention at Atlantic City.

During the past ten days a very extensive exhibit of material and apparatus for "steam" railways has been made at Atlantic City in connection with the annual meetings of the Master Mechanics and Master Car Builders' Associations. The Steel Pier was occupied to overflowing with these displays, some of which were of a very extensive and pretentious character. As the Electric Light Convention had preceded this gathering, some exhibits were able to shift readily from Young's Pier to the other, but this juxtaposition would hardly explain the manner in which exhibits of an electrical nature are more and more invading the "steam" railway convention. Indeed, it is evident that the revolution or change as to motive power is well begun. Note is made below of the principal exhibits of this nature:

The General Electric Company, Schenectady, N. Y., jointly with the American Locomotive Company, showed on exhibition tracks at the Pennsylvania depot a complete electric locomotive, built for the New York Central Railroad in New York City. An all-steel car for the New York Central electric service, with full electrical equipment, was also exhibited, as well as one of the West Jersey Seashore cars, similarly equipped. At the booth on the steel pier Mr. F. H. Gale dispensed the hospitality of the company, which was represented at the convention by C. C. Peirce, Ralph Moore, L. R. Pomeroy, H. O. Hawkes, W. B. Potter, J. G. Barry, H. D. Tremper and J. R. Lovejoy.

Crocker-Wheeler Company, Ampere, N. J., was represented at the convention by Rodman Gilder, H. C. Petty, F. B. De Gress, Julian Roe, S. Russell, Jr., and H. L. Patterson. Catalogues, pamphlets and literature of the company were distributed from its booth.

Gould Storage Battery Company, New York, exhibited its batteries for signal and train lighting service. This company was represented by Messrs. W. S. Gould and George S. Milne.

Standard Paint Company, New York, had an attractive booth, exhibiting its ruberoid roofing for cars and ruberoid red and brown roofing, flexite metal preservative paints, Giant and P. & B. insulating paper, and P. & B. packing and air-drying varnishes. General Manager Paul M. Wade was present, as well as Messrs. J. N. Richards, E. C. Beckman and H. J. Thomas.

The Bullard Automatic Wrench people, of Providence, R. I., exhibited the famous Bullard wrench, now in general use in steam and electric railway repair shops. Mr. J. L. Blaisdell attended the convention.

Sprague Electric Company.—The Sprague electric monorail crane was exhibited and its actual operation was shown in a space not over 10 ft. or 12 ft. long. Flexible steel armored conductors, Greenfield flexible steel conduits and steel armored flexible cord outlet boxes were also exhibited by Messrs. A. E. Bradford, A. C. Bakewell and F. S. Douglass.

National Brake Company, of Buffalo, N. Y., was represented at the convention by its treasurer and general manager, G. S. Ackley and E. C. Rutherford, of Toronto, Can. A type of brake, similar to the well-known Peacock brake now in universal use on electric roads, applicable to steam passenger and freight car service, is being marketed by this company.

Cling Surface Manufacturing Company, Buffalo, N. Y., had a neat exhibit, illustrating the difference between belts treated with Cling surface and ordinary belts. Mr. F. Chase, of New York, attended.

Vacuum Cleaner Company, New York, had a very interesting exhibit on the exhibit track at the Pennsylvania Railroad station, in a Kenny portable vacuum cleaning plant, for both steam and electric railroad. It is especially adapted for this purpose, as it can be moved with facility and ease from one part of the road to the other. The company was represented by R. C. Hallett.

H. W. Johns-Manville Company, New York, had a very complete exhibit of all of its asbestos products, transite for the fire-proofing of electric railroad cars, fire-proof lumber fibres and cements, asbestos textile materials, pipe covering cement, felting and roofings, Vulcasbestos, piston rod packing, throttle rod packing, Keystone combination pump packing and its 85 per cent magnesia and fire-felt sectional boiler lagging. The company was represented at the convention by Messrs. J. W. Perry, L. B. Melville, J. C. Younglove, M. Fuhrer, W. F. Taylor, E. C. Sawyer, F. M. Gilmore, H. O. Fettinger and J. E. Meek.

Yale & Towne Mfg. Company exhibited 20-ton triplex chain blocks, 2-ton electric hoists built in trolley, 2-ton electric hoist with graduated speed control, 5-ton triple chain block in operation under load, one triplex and differential chain block, etc. Messrs. W. C. Bigelow and C. W. Beaver were present.

Jos. Dixon Crucible Company displayed the various Dixon graphite specialties and lubricants. The company was very liberal in the distribution of its lead and indelible pencils. It was represented by W. A. Houston, Lewis F. Lyne, Malcolm McNaughton, E. M. Taussig and C. H. Spatts.

Niles-Bement-Pond Company, New York, exhibited at the Pennsylvania Railroad depot a 90-in. extra heavy driving wheel chucking lathe. The company also entertained its friends and delegates at its booth on the ballroom stage on the steel pier. The representatives present were D. A. Normolye, Frank B. Ward, E. C. Lewis, Jos. K. Cullen, George T. Watts, J. P. Ilsby, L. A. Williamson, J. J. Hay, W. W. Ricker, H. M. Cleaver.

The General Storage Battery Company, New York, exhibited its Bijur battery for signal car lighting and power regulation. The company was represented by R. C. Shaal and F. E. Booss. As at the Electric Light Convention, the battery received very favorable comment.

The Westinghouse Exhibit consisted essentially of the display of air brake apparatus made by the Westinghouse Air Brake Company, which was represented by M. J. R. Ellicott and his large staff of assistants.

Bell Telephone Company, as in the case of the National Electric Light Association, extended special courtesies and facilities the members. To secure uninterrupted connections between the pier, the city system of Atlantic City and the long-distance trunk lines, an independent cable with twenty trunk lines was installed between the switchboard in the Atlantic City office and the temporary exchange at the company's booth in the center of the south side of the music hall.

Carborundum Company, of Niagara Falls, had an interesting exhibit of its cŏrborundum specialties adapted for filing and cutting work, as a highly successful rival of emery. This abrasive is popular among railroad men as well as other mechanical managers. The concern was represented by Messrs. E. J. Eames, W. W. Sanderson, C. O. Taylor and C. C. Schumaker.

Dearborn Paint Company, of Chicago, had an exhibit of its paint and of its crude materials. It showed also acid and alkali-proof jars, battery boxes, etc., and was represented by Messrs. J. R. Van Allen and L. F. Lindley.

Electric Storage Battery Company, of Philadelphia, had a fine exhibit of its Chloride accumulators for railroad electrification showing two complete cells of the recently designed R type; a switchboard equipped with carbon regulator, automatic water-filling apparatus and recording hydrometer for pilot cells; Chloride accumulators for car lighting service, showing six types of two-compartment cells with specially designed containing vessels; Chloride accumulators for signal and interlocking service, showing stationary and portable types. The company, which has received large orders from the New York Central Railroad for its new electrical equipment, was represented by Messrs. Chas. Blizard, general sales manager; J. A. White and H. E. Hunt.

Lincoln Electric Manufacturing Company, of Cleveland, had a line of variable-speed motors specially applicable to machine tool drive in railroad shops. Mr. H. M. Hitchcock was present on behalf of the company.

J. T. Ryerson & Son, of Chicago, had a large variety of appliances and tools for locomotive and other railway work, car and track jacks, flue cleaning and welding machines, motor-driven shears, etc.

United States Light & Heating Company, of New York, had an equipment of its well-known train lighting system, represented by Mr. John J. Moore, the veteran central station expert and manager of the earlier Thomson-Houston régime.

The Allis-Chalmers Company, of Milwaukee, was represented at the convention by Messrs. F. C. Randall, C. A. Tupper and Guy Slafer. The company's booth was devoted to showing samples of stationary motors for repair shops and steam turbine vanes and discs.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Satisfactory conditions are reported in trade and industry considering the season of the year. General business is of average proportions, but in many lines it is in excess of a year ago. Fall orders for many lines of goods are coming forward in goodly volume, and jobbers appear optimistic as to the outlook. Machinery is generally well employed and the labor situation, while still disturbed at some points, has somewhat improved. Crop reports are more satisfactory, and the outlook is for a very good yield of wheat, though damage reports are numerous. In the cotton belt the situation is brighter, except at a few points, Georgia particularly, where severe rainfalls have damaged the plant. There is a slightly better tone to pig iron, the production of which is decreasing, and consumption is heavy, that fact preventing any large accumulation of stocks. Railway earnings are very large, the increase for May being over 14 per cent, this being the highest on record for May. Money continues easy, and collections range from fair to good. Building is active with a consequent heavy demand for hardware and materials in general. Copper is quiet, but prices are firmly maintained. Lake closed at 18 13/16c., Electrolytic, 18½, and casting stock 18 5/16. There were, according to *Bradstreet's,* 170 business failures in the week ending June 14, against 162 the week previous and 175 in the corresponding week last year.

THE OUTLOOK FOR COPPER.—Walker's copper letter to the *Boston Commercial* says: "Copper is quiet, but continues very strong. Lake is held at 18¾c. to 19c. per lb. for August and September delivery; electrolytic for nearby delivery is 18¾c., for September, and October delivery 18½c. to 18⅝c.; casting is 18¼c. to 18⅜c. There is a strong demand for prime grades of casting copper. The domestic situation is quiet at the moment and without special feature. Demand from European consumers continues strong. The recent activity of the foreign buying shows its effect in the copper exports for Europe, which are increasing steadily. Producers generally do not look for a very large increase this year over the output of 1905. Meanwhile the metal is going into consumption as rapidly as it can be produced, and there are many indications that this condition will continue for several months to come. The extensions now being added to several of the large refining plants in the East when completed will help to ease conditions and will also facilitate a more rapid turning over of copper from producer to consumer. The refining plants are now crowded to their utmost capacity, yet they are not able to keep pace with the demands being made on them." It is stated, with regard to the strong demand from Europe, that one producer booked 12,000,000 pounds of wire bars for September, October and November shipments to an electrical corporation which has two plants along the Rhine. Another German corporation in the electrical field is negotiating for 18,000,000 pounds, to cover requirements for the last quarter of the year. In speaking of the remarkable prosperity of Germany's copper consuming interests, one of the most important copper producers in the West informed the *New York Sun* that the largest consuming interest in American wire bars in Germany increased its 1905 business 62 per cent over the previous year, and its increase in the first four months of this year exhibits an increase of 26 per cent. over the corresponding period of 1905. This corporation has business on its books in cables alone that will call for the consumption of 20,000,000 pounds of American copper during this year.

POWER CABLES IN BROOKLYN.—The Department of Water Supply, Gas and Electricity has granted a permit to the Brooklyn Rapid Transit Company for the installation of its new 5,600-volt cables on the surface and elevated extension which the company has recently built to Canarsie. The granting of the permit was held in abeyance for nearly two months, pending an opinion by the corporation counsel as to whether the company had a right, through the provisions of its charter, to install cable of such high pressure. The corporation counsel, in an opinion rendered last week, said the company was entirely within its rights. The steam road which formerly ran between East New York and Canarsie has been rebuilt and connected with the Fulton Street "L" structure. At New Lots Road the trains will descend and run on the surface to Canarsie. High-speed motor trains will be operated over the line.

ROLLING STOCK FOR SAN FRANCISCO.—For the equipment of their new rolling stock, made necessary by the recent fire, the United Railroads of San Francisco have placed large orders with the General Electric Company for various types of railway motors. These include twenty-five four-motor, 40-hp equipments; fifteen four-motor, 50-hp equipments, and ten four-motor, 75-hp equipments. All will be supplied with the flexible Sprague-General Electric system of multiple-unit control. The United Traction Company of Albany, N. Y., has recently ordered twenty-five four-motor equipments, and the Philadelphia Rapid Transit Company, 100 four-motor equipments. In several instances the GE-80 is being substituted on cars already using a less efficient motor. Thirty-six equipments of four motors each were recently ordered by the St. Louis Railway Company, to replace old motors.

PLANT FOR ALBANY CAPITOL.—Following a meeting of the New York State Board of Trustees of Public Buildings, consisting of the Governor, Lieutenant Governor and Speaker of the Assembly, Governor Higgins has announced that the contract for installing an electric lighting plant in the basement of the Capitol had been awarded to W. N. Sheehan & Co., of New York, at their bid of $43,100. The contract stipulates that the work shall be completed within four months. In addition to lighting the Capitol, the state will light the State Hall, Geological Hall and the executive mansion. An appropriation of $65,000 was made for the work several years ago, but no definite action was taken until recently. The Capitol and other state buildings at the present time are lighted by the local lighting company.

WESTERN ELECTRIC WIRE PLANT.—It is stated that the Western Electric Co., which uses over 75,000,000 pounds of copper annually, is now making arrangements with a prominent manufacturing concern to erect a new plant for the exclusive purpose of making for it certain sizes of copper wire. The capacity of the plant will be 100,000 pounds of wire weekly, calling for nearly 5,000,000 pounds of copper every year. The Western Electric Co. maintains the largest factory of its kind in Belgium. It is credited with being the second largest consumer of copper in the world, being exceeded in amount used by the American Brass Co.

LAREDO FEDERAL BUILDING.—Sealed proposals will be received at the Treasury Department, office of the Supervising Architect, Washington, D. C., until 3 o'clock p. m. on July 17, and then opened, for the installation of a conduit and wiring system for the U. S. Post Office, Court House and Custom House at Laredo, Tex., in accordance with drawings and specification, copies of which may be had in Washington or at the office of the Superintendent of Construction, Laredo, Tex., at the discretion of the supervising architect.

CROCKER-WHEELER ORDERS.—The Crocker-Wheeler Company, of Ampere, N. J., has recently sold the Wm. Cramps & Sons, Ship & Engine Company, of Philadelphia, Pa., eight 5½-kw motor-generators for the U. S. Navy gun elevating equipments. The company has also received an order from the Columbia University, University Heights, New York City, for one 450-kw, 250-volt, direct-current generators for lighting and power for the University.

B. R. T. ORDERS.—The Brooklyn Heights Electric Railway Co. has concluded arrangements with the Westinghouse Traction Brake Co. to equip 100 new surface cars with motor-driven straight air brakes for the passenger division of the road. This order brings the total amount of air brake sets up to 527, which the Westinghouse Company has furnished to the Brooklyn Heights system within the last eighteen months.

STANLEY INSTRUMENT COMPANY, of Great Barrington, Mass., has been bought out by the General Electric Company. Adverse patent litigation restricts the operations of the company, which was incorporated a few years ago for the manufacture of electrical measuring instruments, with a capital stock of $300,000, and turned out some excellent apparatus.

THE LOS ANGELES RAILWAY CO has ordered from the Westinghouse Electric & Manufacturing Co. at one time 200 40 horse-power electric motors, which will be used in the equipment of fifty cars which the company is adding to its rolling stock.

THE DE LA VERGNE MACHINE COMPANY, of New York, reports the following recent sales of the well-known "Hornsby-Akroyd" crude and fuel oil engines. The Fulton Bag & Cotton Mills, Atlanta, Ga., 50-hp engine to drive general machinery; F. P. Pfleghar & Son, New Haven, Conn., 125-hp engine direct connected to generator; Wissahickon Electric Company, Fort Washington, Pa., 50-hp engine; Iola-Aurora Production Company, Iola, Kan., 20-hp engine for driving general machinery; Marconi Wireless Telegraph Company of America, New York City, 7-hp engine for furnishing power for wireless telegraph station.

Financial Intelligence.

THE WEEK IN WALL STREET.—Prices on the New York stock market were heavy under liquidation by pools and bearish activity on the part of traders. The feature was the weakness of leading stocks, such as Reading, Union Pacific and Erie, while some strength was exhibited in the Pennsylvania group. The market in general was narrow and entirely professional. Money was easy and the indications are that until the interior cities begin to draw money for crop-moving purposes, there will be little likelihood of any particular change in interest rates. Adverse crop reports from the West did not seem to receive any great attention. United States Steel stocks declined without any apparent reason. At the close of the week the general market was heavy and exhibited a downward tendency. The electric and traction stocks were also weak and in most all cases declines are noted. Allis-Chalmers common closed at 21 and preferred at 57, these quotations being net declines of 1½ and 2½ respectively. General Electric is 4 points lower on the week's business, the closing quotation being 166, ex.-div. Westinghouse, on the other hand, gained 2 points net, closing at 161. American Locomotive common closed at 69⅝ and preferred at 115, both of these quotations representing small declines. Brooklyn Rapid Transit closed with a net loss of 4 points and Inter-Metropolitan common with ⅜ and preferred 1⅞, the closing quotations being 80, 50 and 83, respectively. The last quotation of Metropolitan Street Railway was 113½. The curb market in the main followed the lead of the Stock Exchange list, with general recessions, under profit-taking or liquidating sales. In only a few exceptional cases were prices put up. Following are the closing quotations of June 19:

NEW YORK

	June 12	June 19		June 12	June 19
Allis-Chalmers Co.	21¾	20¾	General Electric	171⅛	166
Allis.Chalmers Co. pfd.	57	57⅛	Hudson River Tel.	...	...
American Dist. Tel.	25	30	Interborough Rap. Tran.	...	...
American Locomotive	72¾	71⅛	Mackay Cos.	76	74⅜
American Locomotive pfd.	115	115	Mackay Cos pfd.	74¾	78
American Tel. & Cable	90	91	Marconi Tel.	...	...
American Tel. & Tel.	139	137	Metropolitan St. Ry.	112	104
Brooklyn Rapid Transit	84⅛	80⅛	N. Y. & N. J. Tel.	...	...
Electric Boat	18	25	Western Union Tel.	92⅜	92¼
Electric Boat pfd	65	70	Westinghouse com.	158	156
Electric Vehicle	11	10	Westinghouse pfd.	...	...
Electric Vehicle pfd.	18	16			

BOSTON

	June 12	June 19		June 12	June 19
American Tel. & Tel.	139¼	138¼	Mass. Elec. Ry. pfd	73⅞	70
Cumberland Telephone.	118	...	Mexican Telephone	4	3¾
Edison Elec. Illum.	238	246	New England Telephone	134⅜	135
General Electric	171¼	172⅜	Western Tel. & Tel	...	...
Mass. Elec. Ry.	22⅛	20¼	Western Tel. & Tel. pfd.	...	92

PHILADELPHIA

	June 12	June 19		June 12	June 19
American Railways	52	51¾	Phila. Electric	8¾	8⅛
Elec. Co. of America	11⅝	11¾	Phila. Rapid Trans.	25	24⅛
Elec. Storage Battery	73	72	Phila. Traction	99	98¾
Elec. Storage Battery pfd.	...	..			

CHICAGO

	June 12	June 19		June 12	June 19
Chicago City Ry.	174*	170	National Carbon	80	83
Chicago Edison	149	...	National Carbon pfd.	119	119
Chicago Subway	54¼	..	Union Traction	...	...
Chicago Tel. Co.	...	...	Union Traction pfd	...	...
Metropolitan Elev. com.	28¼	26			

* Asked

DIVIDENDS.—Directors of the Electric Boat Co. have declared the regular quarterly dividend of 2 per cent on the preferred stock, payable July 2. Twin City directors have declared the regular preferred quarterly dividend of 1¾ per cent, payable July 2. The guaranteed quarterly dividend of 1¾ per cent on the Manhattan Railway Co. will be paid on and after Monday, July 2. The semi-annual dividend of 2 per cent on the stock of the Consolidated Tractions of New Jersey is payable July 15. This dividend puts the stock on a 4 per cent per annum basis, as required by the lease to the North Jersey Street Railway Co. The last dividend was at the rate of 3½ per cent per annum. Directors of the Garvin Machine Co. have declared the usual semi-annual dividend of 3½ per cent., payable July 2. The regular quarterly dividend of 1¾ per cent on Metropolitan Street Ry. is payable July 16. The directors of the Washington Water Power Co. have declared the regular quarterly dividend of 1¾ per cent, payable July 2. A dividend of $3 per share has been declared on the capital stock of Indianapolis Street Railway Co., payable June 30. The directors of the United Railways Investment Company of San Francisco have declared another scrip dividend on the preferred stock. The dividend is at the rate of 2½ per cent, and is for the period from September 30, 1905, to March 31, 1906. The scrip bears interest at 5 per cent. The directors of the Cumberland Telephone & Telegraph Co. have declared the regular quarterly dividend of 1¾ per cent, payable July 2. The Philadelphia Co. directors have declared a regular quarterly dividend of 1½ per cent on the common stock, payable August 1. A dividend of 75 cents per share has been declared on Reading Traction Co. stock, payable July 2. The directors of the United Railways Investment Co. have declared a regular semi-annual dividend of 2½ per cent upon the preferred stock, payable in scrip bearing interest at the rate of 5 per cent per annum from the date of issue to the date of redemption. The dividend is payable July 2. The directors of the Westinghouse Air Brake Co. have declared the regular quarterly dividend of 2½ per cent and the usual extra dividend of 2½ per cent, payable July 10. Directors of the United Gas Improvement Co. have declared a dividend of 2 per cent ($1.00 per share), payable July 14. Directors of the Otis Elevator Co. have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable July 16. The Western Union Company has declared the regular quarterly dividend of 1¼ per cent. The Consolidated Car Heating Company has declared the regular semi-annual dividend of 1½ per cent, payable August 1. The Hudson River Telephone Company has declared the regular quarterly dividend of 1½ per cent, payable July 16. The Bell Telephone Company, of Canada, has declared a dividend of 2 per cent, payable July 16. The Canadian General Electric Company, Limited, has declared a semi-annual dividend of 3 per cent on its preferred stock and a quarterly dividend of 2½ per cent on its common stock, both payable June 30. The Toledo Home Telephone Company has increased its dividend rate from 5 to 6 per cent, payable quarterly. The directors of the Columbus, O., Railway & Light Company have declared a dividend of 1 per cent on the capital stock, payable July 16. The directors of the International Nickel Co. have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable August 1. The directors of the National Carbon Company have declared a dividend of 1 per cent on the common, payable July 15.

AUTOMATIC ELECTRIC STOCK.—The Automatic Electric Company, says a Chicago dispatch, is preparing to increase its capital stock from $4,000,000 to $5,000,000. The proceeds of the issue, which is to be sold to the shareholders at par, will be used to enlarge the company's Chicago plant. The company manufactures automatic switchboards and telephones under the Strowger patents, and its growth of business in four years has now reached a point where immediate expansion is necessary. The company pays 8 per cent dividends, and interests behind it are almost identical with those of the Illinois Tunnel Company, now controlled by the Chicago Subway Company.

ALLIS-CHALMERS BONDS.—It is announced that a plan to create a bond issue of several million dollars in connection with the contemplated extensions of the Allis-Chalmers Co. will be submitted to stockholders. The fiscal year of the company ends June 30, 1906. The Allis-Chalmers Co. has shown a great improvement in earning power over the last twelve months, and the statement for the current year is expected to reveal a substantial increase in earnings. The report for the year ended June 30, 1905, showed net earnings of $68,982 after deducting $1,077,999 for maintenance and depreciation. The preferred stock outstanding is $16,150,000, and there is $19,820,000 of common stock. The current quotations are around 57-58 and 21-22.

N. Y. & N. J. TELEPHONE.—A special meeting of the directors of the New York & New Jersey Telephone Co. was held this week, at which it was voted to offer to stockholders at par $1,721,140 new stock. Stockholders of record June 30, 1906, will be entitled to subscribe in the ratio of one share of new for every ten shares of present stock. The right to subscribe expires July 31, and payment in full will have to be made before August 1, 1906. The capital stock of the company on December 31, 1905, was $17,360,000 and the company's plant was carried on the balance sheet, including equipment, at more than $17,000,000. The business is growing very rapidly.

MEXICAN TELEGRAPH STOCK.—The Mexican Telegraph Company has listed $1,000,000 additional capital stock on the New York Stock Exchange, making a total of $3,000,000.

CHICAGO EDISON STOCK went off to 145 this week on the vetoing of its new franchise by Mayor Dunne.

LIGHTING RESULTS AT LOWELL, MASS.—The Lowell Electric Light Corporation, Stone & Webster, managers, reports as follows:

	April, '06.	April, '05.	Increase. or decrease.
Gross earnings	$21,389.79	$20,139.11	$1,250.68
Operat'g exp., incl'd'g taxes	14,904.06	12,374.16	2,529.90
Net earnings	$6,485.73	$7,764.95	$1,279.22*
Interest charges	662.51	734.90	72.39*
Balance	$5,823.22	$7,030.05	$1,206.83*
Bond sinking fund	579.16	579.16	....
Balance	$5,244.06	$6,450.89	$1,206.83*

REPORT FOR 12 MONTHS ENDING.

	April 30, '06.	April 30, '05.	Increase.
Gross earnings	$265,951.90	$242,974.94	$22,976.96
Operat'g exp., incl'd'g taxes	167,084.41	137,334.24	29,750.17
Net earnings	$98,867.49	$105,640.70	$6,773.21*
Interest charges	8,687.68	12,868.98	4,181.30*
Balance	$90,179.81	$92,771.72	$2,591.91*
Bond sinking fund	6,950.00	6,950.00	....
Balance	$83,229.81	$85,821.72	$2,591.91*

*Decrease

Construction charges during month of April, 1906..... $1,532.47
Construction charges during 12 months ending April 30, '06.. 15,298.51

CONDENSED BALANCE SHEET.
April 30, 1906.

Assets—		Liabilities—	
Plant	$1,037,940.80	Capital stock	$650,000.00
Current assets	33,178.76	Bonds	137,000.00
Bills receivable	25,805.68	Notes payable	20,000.00
Trustees of bond sinking fund	38,950.41	Accounts payable	16,100.64
		Bills not yet due	39,758.96
Suspense	3,401.06	Premium on sales of capital stock	22,831.50
Cash	3,949.32	Bond sinking fund	91,950.41
		Reserves and surplus	165,584.52
	$1,143,226.03		$1,143,226.03

LIGHTING AT BROCKTON, MASS.—Stone & Webster report as follows on the operations of the Edison Electric Illuminating Company of Brockton:

	April, '06.	April, '05.	Increase.
Gross earnings	$12,938.99	$10,508.94	$2,430.05
Operat'g exp., incl'd'g taxes	9,957.97	8,195.38	1,762.59
Net earnings	$2,981.02	$2,313.56	$667.46
Interest charges	729.17	669.61	59.56
Balance	$2,251.85	$1,643.95	607.90

REPORT FOR 12 MONTHS ENDING.

	April 30, '06.	April 30, '05.	Increase.
Gross earnings	$154,044.51	$129,182.74	$24,861.77
Operat'g exp., incl'd'g taxes	108,570.22	83,089.89	25,400.33
Net earnings	$45,474.29	$46,092.85	$618.56*
Interest charges	8,690.48	9,400.87	710.39*
Balance	$36,783.81	$36,691.98	$91.83

*Decrease.

Construction charges during month of April, 1906..... $7.65
Construction charges during 12 months ending April 30, '06.....13,044.07

CONDENSED BALANCE SHEET.

April 30, 1906.

Assets—		Liabilities—	
Plant	$429,306.76	Capital stock	$250,000.00
Current assets	12,939.74	Bonds	100,000.00
Bills receivable	17,540.85	Coupon notes	75,000.00
Trustees of coupon note sinking fund	5,000.00	Accounts payable	2.815.65
		Bills not yet due	9,162.38
Cash	15,528.87	Suspense	626.21
		Coupon note sinking fund	5,000.00
		Reserves and surplus	37,711.98
	$480,316.22		$480,316.22

MACKAY COMPANIES' CONDITION.—The banking house of Osler & Hammond, of Toronto, has issued a circular bearing on the Mackay Companies, which says: "The chief underlying company is the Commercial Cable Co.—that company owns about $7,000,000 worth of railroad and other bonds which produce a constant income besides being a great reserve strength to the company. The gross and net receipts of the Commercial Cable Co. are continually increasing, particularly with the extension of its cable system by a fifth cable laid in the Atlantic last year. So also the gross and net receipts from the land line system are continually increasing. The Postal Telegraph Co. has telegraph contracts with the Pennsylvania Railroad, the Illinois Central Railroad Co., the Canadian Pacific Railway, the Chicago Great Western Railway, the Soo Line, and a number of other railroad companies, and the company is devoting its attention to increasing the number of such contracts where satisfactory and remunerative arrangements can be made. We are advised on the best authority that if in each year the entire profits of the Commercial Cable Co. and its land line system were paid to the Mackay companies, as might legally be done, and if the Mackay companies used all these profits, together with its income from other sources, for the payment of dividends, the amount would be sufficient to largely increase the present dividend on the common stock.

RHODE ISLAND TROLLEYS.—Advices from New Haven, Conn., state that the negotiations with the United Gas Improvement Company, of Philadelphia, for the acquisition of the trolley lines in Rhode Island controlled by that company had been unsuccessful, on the part of the New York, New Haven & Hartford Railroad. The price asked by the United Gas Company cannot be ascertained, but as high as $60 a share has been offered for large amounts of the railway and lighting company's common stock, of which $9,464,100 is outstanding, together with $5,535,900 of preferred stock, or a total of $15,000,000. The negotiations have been in progress for many months, and the question involved has been mainly one of price. In the later stages, however, it is stated authoritatively that the Philadelphia Company, which owns both the Rhode Island and the Connecticut Railway and Lighting Companies, has insisted that both of the great properties be bought together, and the price asked was one which the steam corporation declined to give.

NORTHERN OHIO TRACTION & LIGHT.—It is announced from Pittsburg that all the contracts have been signed and arrangements made for the transfer of the Tucker, Anthony & Co. traction holdings in Stark and Tuscararas counties, Ohio, to the Northern Ohio Traction & Light Co. The properties are owned in Boston, Mass., and are valued at about $4,500,000. The transfer will occur early in July and will include the Canton-Akron line, Canton City lines, Canton-Massillon lines, Canton-New Philadelphia line, and the Tuscararas Traction Co. The Boston people have agreed to accept stock as consideration and take an active part with the Everett-Moore people in the management of the consolidated company. The deal will double the tonnage of the Northern Ohio and make it a property with annual earnings of about $1,600,000.

LEHIGH COAL CO.'S TROLLEY LINE SOLD.—The Tamaqua and Lansford Street Railway Company, owned by the Lehigh Coal and Navigation Company, has been sold to J. G. White & Co., of New York. The negotiations have been pending for some time, J. G. White & Co. desiring the line as part of the consolidation of the Public Utility Companies in and around Pottsville. The Lehigh company received in cash all that was originally paid for the property and in addition $500,000 in securities of the new consolidated company. See page 1284.

DETROIT TELEPHONE SALE.—A number of St. Louis capitalists, including Henry Koehler, Jr., Adolphus Busch and others, are members of the syndicate that has bought the franchise of the Detroit Home Telephone Company, the project being financed by the Commonwealth Trust Company, it being proposed to issue $3,000,000 bonds and the same amount of stock. Detroit telephone properties are sold oftener and faster than any others in this country. It is a "continuous performance."

CHICAGO EDISON.—It is understood that the adjournment of the Chicago Edison annual meeting from June 11 to June 26 was to avoid publication of the annual report while the company's franchise proposition was before the city council. The report is understood to be the best the company has ever put out. As the council has passed the franchise ordinance, the company is free to go ahead with its plan of consolidation with the Commonwealth Electric.

MORE WESTINGHOUSE ACQUISITIONS.—A cable despatch from St. Petersburg says: "It is stated that the Westinghouse Company has bought of the Belgian owners the immense works of the Central Electric Company for the erection of dynamo machines at Moscow for $2,000,000." No details as to this are obtainable in New York, and the data are probably with Mr. Westinghouse, who is expected to return to America at an early date.

PLANT FOR ANTHONY, KAN.—The Citizens' Improvement Company, of Anthony, Kan., is to erect an electric light plant and invites inquiries from concerns desirous of bidding on this work.

ASWORTH, GA., LIGHTING BONDS.—The town of Asworth, Ga., has authorized by popular election the issue of $25,000 electric light and water-works bonds, bearing interest at 5 per cent.

LAFAYETTE ELECTRICAL MANUFACTURING CO., of Lafayette, Ind., of which Mr. Thomas Duncan is president, has increased its capital stock from $35,000 to $70,000.

BURLINGTON, VT., BONDS.—The city treasurer of Burlington, Vt., has awarded to Blodgett, Merritt & Co. $39,000 4 per cent electric plant bonds at 104.077.

GENERAL NEWS.

Construction News.

MOBILE, ALA.—The Council has authorized S. M. Hinckley, chief engineer of the Water Works, to prepare plans and estimates for a municipal electric light plant.

ELBA, ALA.—Work has commenced on the installation of a lighting system in this town by the Pea River Power Company. The company owns a large dam on the Pea River. For the present the company will supply the electricity for the system from a small dam on Beaver Dam Creek.

BESSEMER, ALA.—The Jonesboro Council has granted the Birmingham Railway, Light & Power Company a franchise for 99 years, and in addition to this the company is to be relieved of any taxation for a period of ten years. The Jonesboro line is being rapidly constructed and is expected to be in operation soon. It will probably be extended to reach the mines at Potter.

GADSDEN, ALA.—J. D. Gaboury, of Gadsden, manager of the Alabama City, Gadsden & Attalla Railway Company, and the Gadsden Light Company, announces that on June 25 contracts will be let for buildings and machinery for the proposed power plant, which will furnish power for the street car system, lighting for this city and power for manufacturing plants. The probable cost of the proposed plant is $15,000.

FORREST CITY, ARK.—The city is considering a proposition to buy the lighting plant of the Forrest City Electric Company for $18,500.

PINE BLUFF, ARK.—The City Council has directed that the Pine Bluff Light & Water Company be notified, that under the right reserved by the city, in granting the franchise, the city wishes to purchase the water plant.

LOS ANGELES, CAL.—Bids will be received about July 25 for the construction of an electric light plant.

OCEANSIDE, CAL.—The Sunset Telephone Company contemplates extending and improving its system in the city at a cost of $5,000.

REDLANDS, CAL.—The Tracy Manufacturing Company of Los Angeles has secured the contract for supplying the Redlands Home Gas & Electric Company, with two electric plants, for $57,330.

EUREKA SPRINGS, CAL.—The North Mountain Power Company has recently installed a Westinghouse steam turbine in its plant in this city. The company has contracted with the Eureka Water Company to supply electricity for the pumping station. The company will also soon begin the construction of its distributing system for Fields Landing.

REDDING, CAL.—Contracts have been let by the Northern California Power Company for the machinery and equipment, which will double the capacity of the company's power plant at Volta. The new plant will be a duplicate of the old one, but will be independent, capable of generating 3,000 hp. Two additional reservoirs will be built, one at the head of the pipe line and the other in Macomber Flat, ten miles above. The transmission line from Chico by the way of Tehma to Volta is nearing completion. The company has recently entered into large contracts to supply electricity, which has made it necessary to build the third plant. E. V. D. Johnson is general manager.

DURANGO, COL.—Thomas L. Loftus has applied for an electric light and power franchise in this city.

CRIPPLE CREEK, COL.—The City Council has passed the Frye electric lighting and power franchise with amendments. The franchise will materially cheapen the cost of lighting in this city.

DANBURY, CONN.—The Hudson River & Eastern Traction Company has secured a franchise to build a street railway from Ossining, N. Y., to Sherman Park. Francis A. Stratton, of Mt. Vernon, is president.

HARTFORD, CONN.—The Pratt & Whitney Company is now operating its plant by electric power. The electricity is supplied by the Hartford Electric Light Company, but later on the company expects to install its own power plant.

NEW LONDON, CONN.—The Court of Common Council has granted five franchise applications submitted by the Consolidated Railway Company. The corporation is granted rights to lay double tracks in Main, State and Bank Streets and to build a loop line on Bank Street from Bank Street to Blackhall.

WINDSOR, CONN.—The contract for wiring and installing electric motors for the various machines in the Windsor Print Works has been let to the Plummer Electric Company, of Boston, Mass. The contract calls for the installation of 1,600 lamps in the works. The company plans to operate all of its machines by electric motors.

WINDSOR LOCKS, CONN.—The new corporation which is to take over and consolidate the business of the Enfield Gas Company, the Enfield Electric Light & Power Company, and the Windsor Locks Lighting Company, has filed application in the superior court for permission to operate these companies under the name of the Northern Connecticut Light & Power Company. The new company will furnish gas and electricity for Windsor, Windsor Locks, Thompsonville, Warehouse Point, Enfield and South Windsor. A new power station will be erected at Windsor Locks. Burdett Loomis is president.

DUNNELLON, FLA.—The Council is making arrangements to establish an electric light plant.

PENSACOLA, FLA.—The Pensacola Street Railway Company has decided to electrify the steam division, connecting Pensacola and Fort Barrancas at once, and has also under consideration the extension of what is known as the North Hill line to Goulding, a distance of about three miles.

LUMPKIN, GA.—An election will be held on July 2 to vote on the proposition of issuing bonds for a lighting plant.

ACKWORTH, GA.—H. M. Putnam, City Clerk, writes that the citizens voted June 9 to issue $22,500 bonds for constructing water works and an electric light plant. Bids for construction will probably be received in August.

NAUVOO, ILL.—The Council has passed the new electric light ordinance. It is stated that Mr. Schenk will accept the ordinance and will soon begin work on the installation of an electric light plant.

CHICAGO, ILL.—A franchise has been granted to the American Telephone & Telegraph Company by the Board of Supervisors for the construction of a new telephone system from Chicago to Dubuque. Work will soon begin on the construction of the line.

BELLEVILLE, ILL.—The Belleville Gas & Electric Light Co. has been sold to a syndicate of Chicago, headed by K. A. Ames, the consideration being $500,000. There will be no change in the management at present. Harry Kirchner will be retained as manager. It is said that plans have been made to spend $100,000 in improvements and betterments and that a substantial reduction in both fuel and lighting gas and electric light will be made in the near future.

MUNCIE, IND.—The Central Union Telephone Company will expend over $100,000 in improvements, and will place its wires underground in the business section of the city.

SOUTH BEND, IND.—Plans are being prepared for grading the extension of the Northern Indiana Railway from South Bend to La Porte, a distance of 46 miles. Bids will be called for shortly. A. J. Hammond is chief engineer.

CONNERSVILLE, IND.—The Light, Heat & Power Company of this city is now installing a new generator which will be used in addition to its present equipment. The Board of Commissioners of Fayette County has given the company the privilege of stringing its wires along the highways of the county, and the company will soon be able to furnish electricity for light and power to the farmers of Fayette county.

CRAWFORDSVILLE, IND.—The electric light trustees recently made their annual report and presented the city with $5,000 as the income over expenses during the year. The trustees also reserve $1,000 as a sinking fund for repairs when needed. The people are divided in opinion concerning the advisability of retaining the plant, a good offer having been made some time ago.

MUSKOGEE, I. T.—The citizens of this city have raised $110,000 of the $175,000 to be subscribed for the Grand River dam and power plant.

BEDFORD, IA.—J. J. Clark has petitioned for a franchise for an electric light plant.

SHENANDOAH, IA.—Plans have been made for the new power house of the Artificial Ice, Power, Heat & Light Company, which is to be erected at the corner of Thomas Avenue and Maple Street.

NASHUA, IA.—W. Getsch, Secretary Nashua Water Power Company, writes that about $5,000 will be expended in improvements. The company expects to replace the old wooden dam with a concrete dam with 10-ft. head.

CLAY CENTER, KAN.—At an election held recently the citizens voted to issue $20,000 bonds for a new electric lighting plant.

TOPEKA, KAN.—The Topeka Electric Light Company has petitioned for a franchise. Willard N. Hall and J. W. Owens are interested.

BELLEVILLE, KAN.—W. A. Fuller, of St. Louis, Mo., has secured the contract for constructing the municipal electric light plant, for $18,995.

OTTAWA, KAN.—It is proposed to expend about $80,000 in improving the water works and electric light plant recently purchased. Owen Ford, St. Louis, Mo., is engineer.

MARQUETTE, KAN.—H. E. Bruce, city clerk, writes that it is proposed to construct water works and electric light plant combined, at a cost of about $12,000. B. L. Spindler, of Hutchinson, is engineer.

TOPEKA, KAN.—The Independent Telephone Company contemplates the construction of a new telephone building and several miles of underground conduits in this city. L. M. Wood, architect, can give information regarding the building. Mr. Roberts' electrical engineer has charge of the underground work.

LEXINGTON, KY.—Robert E. Hutton, general manager of the Lexington Light & Power Company, has placed orders for the necessary machinery and equipment for the improvements to the plant.

CROWLEY, LA.—Plans are being made for an electric railway from some point east of Crowley through this city, thence on to Jennings.

ALEXANDRIA, LA.—About $6,000 will be expended for extending the water and electric lighting system to the newly annexed territory.

OPELOUSAS, LA.—The Board of Aldermen has decided to expend about $7,500 in further extending the water works and electric light plant.

NEW IBERIA, LA.—The City Council has granted W. P. Connery, of New Orleans, a franchise for 25 years to operate a street railway through the principal streets of the city. The railway will extend to towns within a radius of 25 miles, making New Iberia the central point.

MARS HILL, ME.—It is stated that an electric lighting plant will soon be erected in this town.

BALTIMORE, MD.—The first of the 2,500-kw generators in the new power house of the Consolidated Gas, Electric Light & Power Company, near Westport, has been placed in commission, and it is expected that before the end of the year the full battery of five generators will be in operation. A new engine of 7,500-hp will soon be installed, in addition to the four McIntosh & Seymour engines of 3,000 hp each already in use. The boiler room is equipped with 18 Babcock & Wilcox boilers of 650 hp each. An auxiliary plant is being installed in the Pratt Street power house. P. O. Keilholtz is consulting engineer; Douglas Burnett is manager of the electrical department.

QUINCY, MASS.—The Quincy Electric Light & Power Company is building a new sub-station at the corner of West and Common Streets.

PITTSFIELD, MASS.—The Pittsfield Electric Company is extending its wires through the grove at Lake Pontoosuc, and is also placing new lamps in Dalton.

SPRINGFIELD, MASS.—The County Commissioners have awarded the contract for the construction of the power house for the Hall of Records to the Fosburgh Company.

WESTHAMPTON, MASS.—The Leather Board Company has made arrangements to light its mill with electric lights and has offered to furnish electricity to light the houses in the village at about cost.

MIDDLEBORO, MASS.—The Committee appointed to investigate the affairs of the municipal lighting plant gave its final report at the adjourned town meeting held June 13. It recommended the purchase of two gas engines in addition to the one already in use, the installation of a 300-hp gas-producing plant, and a new generator and switchboard; that the practice of selling of gas and electricity by contract be discontinued immediately, and that the service be metered. A day service was also recommended. It was voted to appropriate $20,000 to carry out the recommendations.

LOWELL, MASS.—A contract for lighting the suburban districts has been made with the Lowell Electric Light Corporation. The proposition includes the substitution of electric lamps for 400 gasoline lamps. Under the new contract the price of arc lamps is reduced from $120.45 to $100 per lamp per year; gasoline lamps changed to electric lamps and the price reduced from $27.75 per year on a 1 o'clock schedule to $22.60 per lamp per year for an all night and every night schedule. At the end of two years the time the old contract had to run, the question of lower price than $100 will be determined by the board of gas and electric light commissioners. The total saving on street lighting for the next two years will be $26,402.

CADILLAC, MICH.—It is said that the Electric Land and Development Company, of Traverse City, is considering the location of a paper mill here.

VERNON, MICH.—H. A. Sprague and Walter Bush, of Corunna, have been before the Council of this place with a view of securing a ten-year franchise to light the streets with electricity from the Shiawassee power plant, at $50 a light per lamp per year.

HART, MICH.—The Pere Marquette Light & Power Company, of Chicago, Ill., is now taking figures on the construction of a hydro-electric plant, to be constructed on Pere Marquette River in Mason County, Mich. The probable cost of the plant proposed is $120,000. L. J. Highland, First National Bank Building, Chicago, Ill., is engineer.

LITTLE FALLS, MINN.—The Northwestern Telephone Company has purchased the Ward telephone lines in Sauk Center and vicinity and will rebuild them.

SAUK RAPIDS, MINN.—The Sauk Rapids Power Company will commence work on the construction of its new power plant this year. The plant will cost about $500,000.

NASHWAUK, MINN.—The citizens voted June 5 to construct an electric light plant. The probable cost is placed at $5,000. Claussen, Burch & Pillsbury, of St. Paul, are the engineers.

MINNEAPOLIS, MINN.—The Minneapolis General Electric Company announces that a new electric light rate will go into effect July 1, for the consumers of electricity for lighting, which will mean a saving of about 9 per cent. The rate for electric light will be 14 cents per kw-hour for the first fifty-two hours use a month of the maximum demand, 6.66 per kw-hour for all in excess. These rates are subject to a 10 per cent ten-day cash discount, making the net rates 12.6 and 6 cents per kw-hour respectively. The new rate does not affect the city lighting, which under the present rate, effective since June 1, is $84 per lamp per year. The power rates are also unaffected.

KANSAS CITY, MO.—The North Electric Company, of Ohio, has filed articles to show that it had been incorporated under the laws of that State with a capital stock of $250,000, of which $50,000 is to be employed in Missouri, with an office in Kansas City.

ST. LOUIS, MO.—It is reported that the Clark Brothers, of Philadelphia, have acquired control of the Laclede Power Company and the Edison Electric Illuminating Company. The rumor is denied, but as the Clarks have large local interests there is thought to be something in it.

TWIN BRIDGES, MONT.—It is reported that the Conrey Placer Mining Company is contemplating the construction of a large reservoir on the Madison River, in Madison Valley, and will erect two power plants, one at the head and the other at the foot of the canyon. The power is to be used in operating the large dredge boats of the company now in operation at Ruby.

GREAT FALLS, MONT.—The Montana Independent Telephone Company will install a complete local exchange in this city.

BUTTE, MONT.—At a recent meeting of the City Council, the special committee appointed by the Mayor to confer with the management of the two electric light companies in regard to the reduction of the price of electric lights, announced that the Butte Electric Light & Power Company promises to reduce its rates. Beginning with July 1, the present domestic rate, which is 20 cents per kw-hour, will be reduced to 16 cents per kw-hour, with the customary discounts. The rate for stores, etc., which is at present 16 cents per kw-hour, with a flat discount of 10 per cent, will be cut to 16 cents per kw-hour, with a discount of 25 per cent for payment within ten days during the winter months, and 10 per cent discount during the summer months. The all-night rate will be reduced from 14½ cents per kw-hour to 10 cents with the customary discount. In addition to the above rates the company promises to make the minimum monthly rate $1 instead of $2, the present rate. The company also promises the city a rebate of 2 per cent of the gross earnings of the company, in lieu of the 1 per cent rebate now in effect.

ARAPAHOE, NEB.—The citizens have voted to issue $5,000 bonds for the construction of an electric light plant.

CONCORD, N. H.—The addition of the hydro-electric plant of the Concord Electric Company at Sewall's Falls is nearly completed and will soon be in operation. Two Allis-Chalmers turbo-generators of 500-kw capacity each have been installed, and other extensive improvements have been made.

BURLINGTON, N. J.—Municipal ownership of the electric light plant is under consideration here.

TRENTON, N. J.—Preliminary surveys are being made by the Public Service Corporation of New Jersey for the placing of its wires underground on Broad Street. Work will be started as soon as the surveys are completed.

CAMDEN, N. J.—The new power house of the West Jersey & Seashore Railroad at Westville, which is to supply the electricity for operating the third-rail electric system between Camden and Atlantic City, is nearly completed, and is expected to be in operation about the first of July.

NEWARK, N. J.—The special Aldermanic Committee chosen to investigate the feasibility of municipal lighting plant for Newark has decided to retain Runyan & Carey to report on the cost of a plant to light the streets and public buildings, including schools; also on the plan for lighting the City Hall and City Hospital with independent plants, the report to be submitted by October 1.

GREEN ISLAND, N. Y.—The Village Trustees have granted the Hudson River Telephone Company permission to place its wires underground in all of the streets of the village.

NEW YORK, N. Y.—Bids will be received until June 25 by C. B. J. Snyder, Superintendent School Buildings, for installing electric equipment in School 8, Borough of Manhattan.

SODUS, N. Y.—The telephone exchanges of the Empire State Telephone Company and the Wayne-Monroe Telephone Company in this town were entirely destroyed by fire on June 12.

PATCHOGUE, N. Y.—The Village Trustees have granted the New York & New Jersey Telephone Company permission to build a subway for the purpose of putting its wires underground.

ALBANY, N. Y.—W. N. Sheehan & Co., of New York City, have secured the contract for installing an electric light plant in the capitol for $43,100. J. G. White & Co., Inc., 43 Exchange Pl., New York City, are the engineers.

ELMIRA, N. Y.—The Elmira, Corning & Waverly Electric Railway is now securing rights of way for its line. The company has contracted with the Elmira Water, Light & Railroad Company to furnish power for the line beginning with June 1, 1907.

BATAVIA, N. Y.—The Genesee County Electric Light, Power & Gas Company, which recently secured a franchise for supplying the town with electricity, has contracted for four 33-kw transformers to be installed in the sub-station in this village. The company expects to be able to supply electricity in the county about the first of October.

JAMESTOWN, N. Y.—The Council has confirmed the appointments of the Mayor for the new electric light commission, the members of which are as follows: Louis C. Jagger, Warner F. Leidblad, Clayton E. Bailey and Fred Briggs. The light commission will take complete charge of the municipal electric light plant, the government of which heretofore has been vested in the Council.

CHARLOTTE, N. C.—The Southern Power Company expects to be able to furnish power from the Great Falls water power by the first of the coming year. Two dams are being built, one about 40 feet in height, and the second one some distance below, about 90 feet high. The company will transmit electricity as far as Greenville, nearly 90 miles away if conditions shall warrant such a step. Transmission lines are under construction from the falls to Spartanburg, a distance of 65 miles. The

cost of the Great Falls development is placed at $5,000,000, and a great amount has been spent on the development near Yorkville and Fort Mill, 20 miles from Charlotte. The development of Buck Shoals, on the Catawba River, owned by the company, will be started next year.

BORDULAC, N. D.—The New Haven Telephone Company, of which Jay Blakely is secretary, will receive bids until July 2, for 27 miles of telephone line.

FARGO, N. D.—The Northwestern Telephone Company has commenced work on the construction of its conduit system in this city. The company will lay 40,000 feet of conduit.

BOSTON, OHIO.—The Boston Independent Telephone Company has applied for a franchise in this town.

BELLEVILLE, OHIO.—The Belleville Home Telephone Company will increase its capital stock from $10,000 to $75,000.

AKRON, OHIO.—The Central Union Telephone Company contemplates extensive additions to its cable system in this city.

ZANESVILLE, OHIO.—The Zanesville Railway & Light Company has secured a contract to place 17 lamps in Putnam Hill Park and 25 in MacIntyre Park.

AKRON, OHIO.—J. Milton Dyer, of Cleveland, has completed plans for the installation of an electric light plant in the old jail with which to light and heat the county building.

DAYTON, OHIO.—The Dayton Electric Light Company has secured permission to cross the Miami & Erie Canal at First, Second and Third Streets, Dayton, with wires enclosed in ducts.

ALLIANCE, OHIO.—The Sandy Valley Company has laid out a new route for its road between Alliance and Minerva by the way of Mt. Union. Work on the line will start next month.

TORONTO, OHIO.—The Steubenville Traction & Light Company has been granted permission by the City Council to double-track its lines through the city. The entire line from East Liverpool to Steubenville and Wheeling will be double-tracked.

NEWARK, OHIO.—The Ohio Central Railway Company, which was organized here recently for the purpose of building a line from Newark to Lancaster, has secured practically all the right of way, and is now arranging for an entrance to Newark.

KENTON, OHIO.—W. A. Ginn, of Columbus, chief engineer of the Ohio Central Railway Company is making surveys for the proposed line from Newark to Lancaster. The road will run from Thornport to Millersport, thence to Thurston and Lancaster.

CONNEAUT, OHIO.—The Conneaut & Southern Electric Railway Company, promoted two years ago, has been revived. It has been decided to purchase a private right of way between the two cities, instead of operating along the highway as originally proposed.

CONNEAUT, OHIO.—Charles Van Bibber, of Boston, Mass., has the contract for the construction of an electric railway from Erie to Cambridge Springs, Union City and Corry and connecting with Conneaut by the way of Erie. The road will be 40 miles long.

CONNEAUT, OHIO.—Business men of this city are interested in the promotion of an electric railway between Conneaut Lake and Meadville, Pa. Right of way has been secured over a greater portion of the route and a grant has been secured from the Village Council of Lineville, Pa.

FREMONT, OHIO.—The Lake Shore Electric Railway has secured a franchise in Fremont for the entrance for its new Fremont, Sandusky branch. The Erie County Commissioners have granted a franchise through that county. It is stated that construction work will commence this summer.

DAYTON, OHIO.—The Citizens' Electric Company, which recently secured an electric light franchise in Dayton, has submitted to the board of public service plans for the proposed underground system. The company states that it will commence the work as soon as the plans have been approved.

TOLEDO, OHIO.—D. H. James, president of the Toledo & Columbus Railway Company claims that arrangements have been made for the financing of the proposition which contemplates a line from Fremont to Bucyrus, giving through service from Columbus to Toledo in connection with the Lake Shore Electric Railway and the Columbus, Marion & Bucyrus Railway.

PAULDING, OHIO.—The village council has been negotiating for the purchase of the plant of the Paulding Electric Light Company, but the deal is now off, as the company asked $8,500 for the plant and franchise and the village was willing to pay only $6,500. A proposition is now being considered to build a new lighting plant installing the machinery in the water works plant which is being operated at a loss at present.

CLEVELAND, OHIO.—The Forest City Railway Company has been granted a franchise to lay a track on Fulton Street from Franklin Avenue to Lorain Street. M. A. Fanning, president, claims that the line on Denison Avenue, Rhodes Avenue and Fulton Street will be in operation this fall. Equipment for a temporary power station has been ordered. The company has made application to the city for an extension of its Denison Avenue line.

TOLEDO, OHIO.—J. Y. Todd and S. N. Young, of Toledo, who are promoting the Cleveland, Norwalk & Indianapolis Railway, are making rapid progress in the preliminary work for the building of this line. It will extend from Norwalk, Ohio, to Bluffton, Ind., connecting Cleveland and Indianapolis. Engineers are now at work making surveys from Bluffton to Van Wert, Ohio. The Riggs & Sherman Company, Toledo, is in charge of the engineering work.

SALEM, OHIO.—The Youngstown & Ohio River Railway has started work on its line between Leetonia and Columbia. This will connect the Youngstown & Southern with the Salem Railway, both of which are now steam roads, but are to be electrified and operated in conjunction with the Youngstown & Ohio River Railway. Contracts for the overhead materials are to be placed at once and it is expected to have cars running between Youngstown and Salem this fall.

CLEVELAND, OHIO.—A new suburban line between Cleveland and Elyria has been projected under the name of the Cleveland, Brooklyn & Elyria Railway, with $100,000 capital stock, by B. E. Ottman and W. E. Elliott, of Cleveland; L. J. Weadock and J. H. Knisley, of Toledo, and O. A. Thomen, of Elyria. It is proposed to construct a line from South Brooklyn through Eaton, Columbia and Strongsville, and thence to Elyria. The headquarters of the company will be in Elyria.

TOLEDO, OHIO.—The Toledo Gas, Electric & Heating Company, which has recently consolidated three gas electric and heating plants in this city, will close down the lighting equipment at the 22nd and the Floyd Street stations and will install motor-driven pumps for circulating hot water and rotary converters for handling power which will be generated at the Detroit Avenue station. A 3,500-kw Westinghouse-Parsons turbine is now being installed in this station giving it a total capacity of 8,150 kw.

MANSFIELD, OHIO.—The Cleveland, Ashland & Mansfield Railway Company, headed by G. A. Bartholomew and Thomas W. Latham, of Cleveland, has commenced work on its line between Ashland and Mansfield; as soon as it is completed the company will build north through Savannah and Greenwich to North Fairfield, where connection will be made with the Sandusky, Norwalk & Mansfield Railway. A power station will be erected at Ashland. It is expected that the first section of the road will be completed next spring.

GALLIPOLIS, OHIO.—The Gallipolis, Huntington, Ironton, Portsmouth & Columbus Railway Company, recently incorporated by Col. A. E. Boone, of Zanesville, proposes to build a large system of traction lines radiating from Gallipolis. There will be four divisions of the system as follows: Ohio River division, Gallipolis to Ironton and Portsmouth; Cincinnati division, Gallipolis to Waverly and Hillsboro; Columbus division, Gallipolis to McArthur and Lancaster to Columbus, and the Wilson division, Gallipolis to Jackson and Wellston.

TOLEDO, OHIO.—A. H. Sharp, of Columbus, who is at the head of a company which proposes to build a water power plant for the Sandusky River between Tiffin and Ft. Seneca, noted in last week's issue, has notified the city authorities that his company is desirous of bidding for the Toledo street lighting contract at the expiration of the present contract with the Toledo Railways & Light Company. The company proposes to furnish street lamps from $45 to $60, if the city will agree to establish a system of poles, wires and conduits. If the contract is secured it will necessitate the building of a fifty-mile high-tension transmission line from Ft. Seneca to Toledo.

CLEVELAND, OHIO.—The Cleveland Construction Company, of Cleveland, has been awarded the entire contract for building and equipping the line of the Cleveland, Ashland & Mansfield Traction Company. This road will be an extension of the Cleveland & Southwestern Traction Company system branching off from the southern division of that road at Seville and extending to Ashland and Mansfield. The new line to be constructed will be about 46 miles in length. It will be built entirely on private right of way except through villages. The Cleveland Construction Company is to commence work within sixty days, and will close contracts for construction work and material immediately. No power station will be built, and high-tension current will be transmitted from the Elyria power station of the Cleveland & Southwestern Traction Company over two circuits. There will be a cross-country line from the Wellington branch of the system to Polk on the new line, a distance of 16 miles, while another feeder will connect with the southern division of the Cleveland & Southwestern at Seville. The lines will be designed for 33,000 volts transmission, but 20,000 volts will be used at first. There will be five sub-stations, one of them a portable station, while the others are to be located in buildings at Leroy, West Salem, Nankin and Ashland. The sub-stations will be equipped with one 300-kw rotary convertor, two 100-kw transformers, switchboard, lightning arresters, etc. The stations will be of sufficient size to permit of doubling the capacity later. The road will be operated by the Cleveland and Southwestern Company.

CLEVELAND, OKLA.—The Pioneer Telephone Company has purchased the local independent telephone system at Cleveland, Okla., for a consideration of $11,500.

ASTORIA, ORE.—The City Council has granted F. H. Stowe, manager of the Home Telephone Company, a 35-year franchise for an automatic telephone system in this city.

OREGON CITY, ORE.—The power plant of the Portland General Electric Company in this city was badly damaged by fire on June 10. Three of the largest dynamos at the Oregon City station were burned out, three others were ruined by water, a switchboard and all connecting wires were destroyed, putting the plant temporarily out of commission. Temporary arrangements have been made for street lights and railway power. It is reported that it will be fully six months before the company can resume its complete service.

PITTSBURG, PA.—The Allegheny Valley Street Railway Company has filed notice with the State Department at Harrisburg of an increase of $2,000,000 in its capital stock.

HALIFAX, PA.—The Enterline-Halifax Telephone Company will soon ask for a charter to construct a line between the borough of Halifax over the mountains to Enterprise.

WAYNESBORO, PA.—Pen Mar Park and the buildings which belong to it, together with the wide walk from the trolley station to the pavilion, will be lighted with electricity furnished by the Chambersburg, Greencastle & Waynesburg Street Railway Company. Joseph F. Geiser, superintendent of the street railway and electric light plants, will have charge of the construction of the work.

POTTSVILLE, PA.—It is reported that a deal has been closed by a New York syndicate which gives it control of the plants of the Edison Electric Illuminating Company of this place; the Pottsville Union Traction Company's lines, including the Orwigsburg, Heckscherville and Middleport branches; the People's Railway and other trolley lines and electric lighting plant in this region. J. G. White & Co., of New York, N. Y., it is stated, engineered the deal.

KUTZTOWN, PA.—An election will probably soon be held to vote on issuing $10,000 bonds for enlarging the municipal electric light plant in this place.

PITTSBURG, PA.—Charters have been secured for seventeen electric plants, which will form a chain throughout this section. The titles of the companies securing the charters are: Coal Center Electric Company, Washington Electric Company, Monessen Electric Company, Rostraver Electric Company, Twilight Electric Company, Speers Electric Company, Stockdale Electric Company, North Belle Vernon Electric Company, North Charleroi Electric Company, Fallowfield Electric Company, Fayette City Electric Company, East Pike Run Electric Company, Elco Electric Company, Carroll Electric Company, Charleroi Electric Company, Allen Electric Company and California Electric Company. Each company has a capital stock of $5,000, and the directors are Jacob Van Wagner and Clarence W. Scheck, of Pittsburg, and John F. Cockburn, of Bellevue. It is understood that parties connected with the West Penn Railway system are interested in these companies.

CHARLESTON, S. C.—The United States Senate has passed a bill permitting the Charleston Light & Water Company to build a dam across Goose Creek.

CHATTANOOGA, TENN.—It is reported that S. H. Fisk, of the Great Fork's Power is interested in the plan to organize a company to take over the water rights that his company holds and to construct an electric railway from Chattanooga to Nashville.

NASHVILLE, TENN.—The Nashville Railway & Light Company and the Cumberland Telephone & Telegraph Company will soon award contracts for installing their wires in underground conduits. It is estimated that the work for both companies will cost about $400,000.

BRYAN, TEX.—The City Council has granted a franchise to Fritz Brantz to erect and operate an electric lighting and power plant.

FORT WORTH, TEX.—William Capps, attorney for the Northern Texas Traction Company, has announced that the company proposes to begin at once the construction of the South Side lines if the franchise is granted as asked.

FORT WORTH, TEX.—The Rosen Heights Street Railway Company is considering a proposition of constructing a line to the south side. It is also stated that the Fort Worth & Arlington Heights Traction Company has a similar line under consideration.

KAYSVILLE, UTAH.—A committee has been appointed by the Commercial Clubs of Kaysville and Farmington to make an effort to have an electric light and power plant installed, the plant to be owned and operated by the county.

SALT LAKE CITY, UTAH.—E. W. Tatlock and L. R. Derby have made application at the State engineer's office for the appropriation of water to be diverted from the Farmington Canyon for the purpose of generating electrical power for the Davis County. The power plant is to be erected on Farmington Canyon with a capacity of 500 hp.

WINDSOR, VT.—The Windsor Electric Company is contemplating the rebuilding of its electric lighting plant. W. S. Carter has resigned as president of the company, and George S. Rogers has been elected to fill the vacancy. Charles M. Hildreth has been elected vice-president.

LYNCHBURG, VA.—Plans and specifications are being prepared by Lamar Lyndon, of New York, N. Y., for the proposed municipal electric light plant. The City Council has decided to advertise for sale a 30-year franchise for electric lighting and power in this city.

RICHMOND, VA.—The joint committees on Finance and Electricity on June 14, passed a resolution asking the City Council to call for bids for lighting the city by electricity for 3 or 5 years from July 1, 1907.

WALLA WALLA, WASH.—The power plants of the Northwestern Gas & Electric Company on the Walla Walla River and Mill Creek were badly damaged by the floods caused by the severe storm of May 31. The loss is estimated at more than $40,000. E. K. Allen is manager of the company.

SEATTLE, WASH.—The Seattle, Renton & Southern Railway Company has filed an application with the Board of Public Works to double-track about a half a mile of its line in the city limits. In connection with the application the officers of the company have announced that it is the intention to double-track the entire system as fast as the work can be done.

MILWAUKEE, WIS.—The Radcliffe & Porter Manufacturing Company has had plans prepared for a new power house.

FOND DU LAC, WIS.—The Independent Light, Heat & Power Company is endeavoring to obtain a franchise in this city.

MARINETTE, WIS.—The contract for the construction of the new building of the Electrical Manufacturing Company has been let to E. R. Spaulding, of Menominee.

MADISON, WIS.—Bids have been received for the construction of the dam and electrical machinery for the power plant at Kilbourn. P. L. Spooner is interested. Prof. D. W. Mead is engineer.

MARSHFIELD, WIS.—M. G. Fleckenstein, City Clerk, writes that an election will probably be held in July, to vote on issuing $25,000 to be used for improving the water works and electric light plant.

MILWAUKEE, WIS.—The Common Council on June 11 voted to purchase property on Kinnickinnic River, as a site for the municipal electric light plant; also to issue $150,000 bonds toward the construction and equipment for the same.

MILWAUKEE, WIS.—The County Trustees have awarded the contract for the construction of the lighting plant for the county almshouse and hospital to the Milwaukee Engineering Company. The plant will cost $14,000.

BELOIT, WIS.—The Common Council has closed a contract with the Beloit Water, Gas & Electric Company for street lighting for a period of ten years. The company is to furnish 100 or more 2,000-cp arc lamps at $60 per year. This is an increase of thirty over the number of lamps which were in use under the old contract.

SUPERIOR, WIS.—The large power plant of the Great Northern Power Company, which is being erected at Thompson, is progressing rapidly and is expected to be completed before the end of the year. It is estimated that the plant will furnish 80,000 hp, but for the present only 30,000 hp will be developed. There will be installed in the power house three units of 10,000 hp each. The cost of the entire work, which was begun in January, 1905, is estimated between three and five millions dollars.

MEDICINE HAT, CAN.—The City Council proposes purchasing the telephone system here, and have it operated by the city. F. G. Forster is mayor.

CHIGNECTO, CAN.—The Maritime Coal Company is negotiating with the Robb Engineering Company for the installation of a large power plant at this place.

CAMAGUEY, CUBA.—The New Haven owners of the Puerto Principe Electric Company have sold their lighting and tramway property to Canadian capitalists interested with Sir W. Van Horne. The owners were Messrs. I. A. Kelsey, W. G. Bushnell and S. C. Morehouse.

WINNIPEG, MAN.—The Bell Telephone Company is making arrangements to equip a rural system around Glenboro. F. C. Patterson is district manager.

WINNIPEG, MAN.—The Winnipeg Electric Company will build a long-distance telephone line from this city to its power plant at Lac du Bonnet, a distance of 63 miles.

PACHUCA, MEX.—The Cia Electrica e Irrigadora de Hidalgo has recently placed a large order for electrical machinery with the Westinghouse Electric Company to increase the capacity of its power plant. The company has a hydro-electric plant of 40,000 hp, with a transmission line of sixty miles. The company furnishes electricity for the operation of the mines in and around the Pachuca region. Emilo Pinson is chief engineer.

BERLIN, ONT.—The ratepayers endorsed a by-law providing for the expenditure of $ [illegible]00 for a municipal electic light plant to be erected in this city.

HAMILTON, ONT.—Hon. Arthur Kennedy states that he will at once make arrangements for the construction of the Hamilton, Ancaster & Brantford Railroad.

BRANTFORD, ONT.—The Automatic Telephone Company is installing a telephone system in this city, and has decided to erect a large factory for the manufacture of telephone supplies.

OTTAWA, ONT.—The Bell Telephone Company is considering the erection of a large extension to its building in this city, plans for which have been prepared. C. F. Sise is president.

INGERSOLL, ONT.—At an adjourned meeting of the Council the Ingersoll Telephone Company was granted a 28-year franchise. The company, it is stated, will have its system installed and in operation by January 1, 1907.

WELLAND, ONT.—F. W. Houston, superintendent Welland Electric Light Company, writes that work will probably be commenced in about six weeks on the installation of a station at De Cew Falls for the distribution of electric power.

DELHI, ONT.—Bids will be received at the office of Messrs. Quance Brothers, Delhi, until June 25, for constructing a concrete dam, power house, flume, etc. John S. Fielden, 15 Toronto St., Toronto, is engineer of the work.

OTTAWA, ONT.—It is announced that the Grand Trunk Pacific Railroad will build a telephone system in connection with its transcontinental railway from the Atlantic to the Pacific and will also equip all its branch lines with telephones. F. W. Morse, of Montreal, is general manager of the company.

BARRIE, ONT.—The by-law to provide an expenditure of $37,000 for a civic electric lighting plant was carried by the electors. The equipment includes a 450-hp Corliss valve engine, direct connected to a two-phase, 2,200-volt, revolving field generator and all the necessary switches, arc lamps, etc. K. L. Aiken, 164 Bay Street, Toronto, is the consulting engineer.

New Industrial Companies.

THE CHARLES J. BOGUE ELECTRIC COMPANY, of New York, N. Y., has been incorporated by C. J. Bogue, L. Robertson and F. Plante. The capital stock is $50,000. The company proposes to manufacture electrical machinery, etc.

THE GENERAL VEHICLE COMPANY, of Kerhonkson, Ulster County, N. Y., has been incorporated with a capital of $1,750,000, to manufacture and deal in all kinds of motor vehicles. The directors are Phillip S. Hill, Charles H. Clark and Edward T. Magoffin of New York City.

THE SASKATCHEWAN TELEPHONE & ELECTRIC SUPPLY COMPANY, of Saskatoon, Can., has sold out to a local syndicate composed of J. C. Drinkle, Saskatoon; John Wilie, Moosomin, and others. It is understood the new company will make several important extensions.

THE WESTERN CONSTRUCTION & EQUIPMENT COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $250,000. The company proposes to construct railroads, telegraph and telephone lines, machinery, engines, cars, bridges, etc. The incorporators: N. B. Hersloff, Montclair; J. V. H. Lawrence and W. O. Maden, of New York City.

New Incorporations.

DENVER, COL.—The Florida Mesa Telephone Company has been incorporated with a capital stock of $1,000. The incorporators are George W. Spencer and others.

CARLYLE, ILL.—The Citizens' Telephone & Telegraph Company, of Clinton County, has been incorporated with a capital stock of $15,000. The incorporators are Thomas E. Ford and others.

ORLEANS, IND.—The Irwin Telephone Company has incorporated with a capital stock of $6,000. The incorporators are R. E. Challrand, Wm. H. Taggart, Jas. W. Pickens, Aaron Speer, A. T. Marmon and others.

HOWELL, IND.—The Advance Telephone Company, capitalized at $6,500, has filed articles of incorporation with the Secretary of State. The directors are Fred Werkman and D. W. Fauquher, of Evansville, and Henry Young, Henry W. Hartig, of Howell.

COFFEYVILLE, KAN.—A company has been formed for the purpose of building an electric railway from the city to Forest Park, and application will be made immediately for a charter. The directors of the company are: W. H. Shepard, L. L. Birmingham, Dean Gill, S. D. Frazier, James Stanton, C. L. Hollingsworth and J. B. Tackett. The company will be capitalized at $35,000.

NEW ORLEANS, LA.—The New Orleans & Baton Rouge Railroad Company has been incorporated for the purpose of building an electric railway between Baton Rouge and New Orleans. The company has a capital stock of $2,500,000. The stockholders are W. O. Orten, C. S. Young, Edward Godchaux, Rene H. Himel, Walter Godchaux and Ferdinand E. Larue.

SPENCER, MO.—Articles of incorporation have been filed with a capital of $3,300 by the Spencer Mutual Telephone Company by C. C. Kramer and others.

SARCOXIE, MO.—The Sarcoxie Telephone Company has been incorporated with a capital stock of $5,000. The incorporators are H. B. Boyd, Harry Bean. B. W. Ally and others.

HOLT, MO.—Articles of incorporation have been filed for the Clay County Telephone Company, with a capital stock of $50,000. The incorporators are W. H. Smith, J. A. Eby, George W. Sexton and others.

CHARDON, NEB.—The Chardon Telephone Company has filed articles of incorporation with the Secretary of State with a capital stock of $25,000. The incorporators are Adolph W. Rickman and others.

DUNKIRK, N. Y.—The American Lux Light Company has been incorporated with a capital stock of $400,000. The directors are Gustav Berg, Stockholm, Sweden; R. J. Gross and Carl Horberg, of Dunkirk, N. Y.

WILLIAMSON, N. Y.—The Williamson Light & Power Company has filed articles of incorporation with a capital stock of $10,000. The directors are Judson L. Transue of Williamson; Charles W. Mills and George R. Mills, of Sodus.

NEW YORK, N. Y.—The East Side Viaduct Railroad Company, which proposes to build and operate a new elevated line between First Avenue and Avenue A, from the terminus of the New York, New Haven & Hartford Railroad, in the Bronx, to East Thirty-third Street, Manhattan Borough, was incorporated in Albany on June 4. Capital, $50,000. Directors, O. W. Barnes, of Fishkill; F. H. Laamis, of Steubenville, Ohio, and L. C. Twombley, Chas. H. Cook and O. B. Nairs, of New York City. The road will be run by steam or electricity, as is found most convenient.

COLUMBUS, OHIO.—The Jesse T. Sheets Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are Jesse T. Sheets and others.

LARUE, OHIO.—The Larue Telephone Company has filed articles of incorporation with a capital stock of $50,000. The incorporators are J. H. Leonard, W. F. Kniffin, Charles F. Stahl, J. H. Raub and G. C. Allinger.

TIFFIN, OHIO.—The Old Fort Mutual Telephone Company, of Seneca, O., has been incorporated by R. G. Shannon, S. H. Fry, C. J. Fry, N. S. Beck and E. G. Zimmerman. It is proposed to build a mutual telephone system centering at Old Fort

YOUNGSTOWN, OHIO.—The Mahoning Valley Telephone Company, of Youngstown, has been incorporated with $10,000 capital stock by Max M. Zersky, Louise Zersky, Isaac Zersky, Louis A. Zersky and Anna Zersky. It is proposed to build a telephone line through the Mahoning Valley.

CINCINNATI, OHIO.—The Covington, Middlemarch, Fort Thomas & Alexandria Interurban Railway Company has been incorporated by Cincinnati people to build a line along the Kentucky side of the Ohio River from Covington to Fort Thomas and then down the Licking River to Alexandria.

LORAIN, OHIO.—A. H. Hageman, of Lorain, Father Stuber and H. B. Martindale, of Avon, are forming a company to have $20,000 capital stock to build a line through Avon, Dover Center and French Creek and connecting with the Black River Telephone Company at Lorain. The central exchange will be at Avon.

CINCINNATI, OHIO.—Articles of incorporation have been filed for the Cincinnati Independent Telephone Company. The company has a capital stock of $10,000. The incorporators are Edward Puthoff, Charles H. Urban, William Klussmann, Arthur R. Morgan and George W. Griffith. The company proposes to establish a telephone system in the towns in Hamilton County outside of Cincinnati.

GREGG, OKLA.—The Farmer's Mutual Telephone Company has been incorporated with a capital of $30,000 by J. P. Lovingist and others.

ROSSVILLE, OKLA.—The Farmers' Mutual Telephone Company has filed articles of incorporation with a capital stock of $5,000. The incorporators are C. A. Taft and others.

CARMEN, OKLA.—The Carmen Electric Light & Power Company has been incorporated with a capital stock of $12,000 by J. F. and S. A. Mott, of Carmen, and Z. B. Bird, of Enid.

LEBANON, PA.—The People's Electric Light Company has been incorporated with a capital of $10,000. Directors: Geo. H. Heisey, of Lancaster; Geo. B. Woomer, of York; Charles Davies, of Marietta, and others.

BERESFORD, S. D.—Articles of incorporation have been filed for the Gothard Telephone Company. The company has a capital stock of $25,000.

PALESTINE, TEX.—The Palestine Light & Power Company has been incorporated, with a capital of $400,000. John H. Fitzgerald and P. W. Brown, are the incorporators.

COOPER, TEX.—Articles of incorporation have been filed by the Delta Telephone Company with a capital stock of $15,000. The incorporators are C. M. Reed and others.

OTTAWA, ONT.—The Electric Heaters, Ltd., have been incorporated with a capital of $100,000 to manufacture gas, electricity, fixtures, lamps, etc. The directors are: A. A. Sears, W. L. P. Smith and A. F. Leggatt, all of Ottawa.

LONDON, ONT.—The International Electric Company has been incorporated here with a capital of $100,000 to manufacture electricity, electrical machinery, etc. The directors are: A. R. Bickerstaff, G. Stevenson, E. Mackenzie, all of Toronto, Ont.

MONTREAL, QUE.—The Saguenay Electric Light & Power Company has been incorporated with a capital of $250,000 to take over the business of the Cartierville Electric Light & Power Company and to carry on a general business as an electric light and power company.

Legal.

LIABILITY OF MUNICIPALITY.—The Supreme Court of California in the suit of Davonst versus the City of Alameda, has reversed the decision of the lower court favorable to the municipality. The plaintiff's wife was killed by the alleged negligence of the city in operating its municipal electric light plant. The points in the decision are as follows: (1) A municipal corporation in operating an electric plant is not exercising governmental functions, and hence is liable for damages caused by the negligence of its employees in the operation of the plant. (2). Where one was injured through the negligence of the employees of a city in operating an electric light plant, a contention that the city was not liable because the grant of authority to maintain the plant was given to "a board of trustees of the city" and not to the city was untenable. (3) Where one using a way over a vacant lot which had been used for many years by residents in the neighborhood was injured by coming in contact with a live wire of an electric plant negligently lying in the path, the operator of the plant could not escape liability on the theory that the one injured was a trespasser, as he was a licensee.

POLE LINES IN STREETS.—In the case of the Merced Falls Gas and Electric Company versus Turner et al., the Court of Appeal for the Third District of California has ruled against the company as to its undisputable right to maintain its poles in any special locations. The main points in the decision are as follows: (1) Where a gas and electric company had been granted a franchise to construct and maintain its poles in the streets of a city, the original location of the poles by the city's permission created no absolute indefeasible right or irrevocable license to maintain each pole at its particular location for all time. (2) Mere lapse of time is insufficient to create a prescriptive right in a gas and electric company to maintain its

poles in city streets in the identical spot in which they were located. (3) The mere allegation of irreparable injury is insufficient in actions for an injunction. (4) Political Code, §§ 4354, 4408, 4410, 4411, 4413, under which the city is incorporated, vests in the city's board of trustees full power to establish, alter, open, improve and repair streets, remove obstructions therefrom, and generally manage and control the same. Const. art. 11 gives every city power to make and enforce within its limits all local, sanitary, police and other regulations not in conflict with general laws, and the fundamental law of the State also declares that franchises to use the streets shall be exercised under the direction of the superintendent of streets or other officer in control thereof. It is held that where complainant erected certain electric light poles in the streets of a city, it acquired no exclusive right to maintain the same in their original positions, and could not restrain the city from removing them to new locations.

PEDESTRIANS AND WIRES.—The Supreme Court of Georgia in the action of Havell against the Southern Bell Telephone & Telegraph Company has defined some of the rights of pedestrians in a decision of which its own syllabus is subjoined: (1) Where a declaration alleged that a telephone company, in stretching wires along a public street of a city, permitted one of them to sag while heavily charged with electricity, or to become so charged with electricity while thus sagging, at a place where it was likely to injure pedestrians, and gave no warning of the danger arising from such charge, in consequence of which a person walking along the street came in contact with the wire and was seriously injured by the electric charge, this sufficiently stated a case of negligence on the part of the defendant to withstand a general demurrer. (2) It is not negligence as a matter of law for a pedestrian to cross a public street at a point where there is no cross-walk. The use of public streets between crossings is not limited solely to animals and vehicles. Such use by footmen does not necessarily constitute negligence, if due caution is exercised. (3) Where a declaration alleged that a pedestrian was going along a street and started to cross it, when he was struck in the face by a wire which a telephone company had negligently allowed to sag while highly charged with an electric current, or to become so charged while sagging, without giving warning of the danger, and that while seeking to guard his face from the wire, the plaintiff's hands came in contact with it and was injured by reason of the electric current, and that he was without fault or negligence in and about the transaction, and was in the exercise of due caution and diligence, a general demurrer, on the ground that the plaintiff was not in the exercise of ordinary care and prudence for his own protection, and that by the exercise of such care he could have avoided the injury, was properly overruled.

THE MANUFACTURE OF ENERGY.—The Supreme Court of Louisiana in the suit of the State versus the New Orleans Railway & Light Company has held that the lower decision that the company must pay a license tax is sound and that the company is not a manufacturer, under article 229 of the constitution of 1898. The Court said: "It is a debatable question whether an electric light company is a manufacturer. Conceding, for the sake of the argument, that defendant company does manufacture electricity and light, the next question for solution is whether a producer of that kind of energy is a "manufacturer" in the sense of article 229 of the Constitution. In the legislative history of Louisiana the term "manufacturer" has never been applied to a gas, water or electric corporation. Section 683 of the Revised Statutes of 1870 speaks of "manufactures" of cotton, woolen, linen, silk, hempen, cloth and cordage, and of the "manufacture" or iron and other metals and things. It authorized the formation of corporations for the purpose of manufacture and for many other purposes, including the construction and operation of works to supply cities and towns with gas or water. As amended and re-enacted by Act No. 154, p. 288, of 1902, the word "manufacture" is used in the same restricted sense, and is not applied to works of public utility to supply cities and towns with water, electricity, gas or fuel oil. There is no reason of public policy for exempting light companies from taxation and at the same time denying exemption to other corporations exercising similar franchises in the interest of the public. In Commonwealth of Pennsylvania v. Northern Electric Light & Power Company, 22 Atl. 839, 14 L. R. A. 107, the Supreme Court of the State held that, while the defendant company might technically be considered a manufacturer of electricity and light, it was not a "manufacturing corporation" in the sense of a statute exempting the stock of such corporations from taxation.

SPIKES IN LIGHTING POLES.—The Supreme Judicial Court of Massachusetts (Norfolk) has sustained on exceptions the verdict against the plaintiff in the suit of Little versus the Hyde Park Electric Light Company, as to damages for an accident. The point raised was a simple but rather interesting one as to the proper nature of pole spikes used as steps. The plaintiff's case was that the spike which gave way under him was not a suitable spike for the purpose for which it was used, and that it was not properly driven into the pole. But in testifying that the superintendent promised a year before the accident to take out all driven spikes, and substitute screw spikes, the plaintiff admitted that he knew that driven spikes were then in the poles. It is true that he did not admit that he knew that driven spikes of the kind in question were in use, and there was evidence that they were more dangerous than beveled driven spikes. But he admitted in terms that "steps getting loose was not an infrequent occurrence during my time of employment," and "I would tell a step was loose by the feeling of it when I took hold of it, I suppose." The rest of the evidence touching on the plaintiff's due care is as follows: The plaintiff had been in the defendant's employ as a lamp trimmer for 11 years. As such it was his duty to climb each post belonging to the defendant (at the time of the accident there were 139) every other day, except on moonlight nights, and on those every three to five days. When the plaintiff's time was not wholly taken up trimming the lamps because there was a moon, he worked as a lineman in making repairs, including taking down and setting up poles. In that connection he had seen poles bored for spikes and new spikes put into poles, although in his testimony he did not admit that he personally had bored more than one hole for the driving of a spike, or had driven more than that one spike for which he had bored the hole. He testified that it was his duty to make a daily report on a blank furnished by the defendant for the purpose, and that one of the headings on this blank was: "The following repairs are needed on the circuit." He also testified that it was his duty to put upon that blank anything that might be seen to be needing repairs. He further testified that if he found a pole where a step was loose which he could not repair himself (although he did not think he ever had been told to do it), he thought he ought to report it and he did report it. Other evidence went to show that it was left to the trimmer to report needed repairs.

DEADLY GUY POST WIRE.—The Supreme Court of Wisconsin has affirmed against the Sheboygan Light, Power & Railway Company the decision for plaintiff in the suit of Wilbert versus F. Zurheide Brick Co., et al., on the ground that the defective insulator causing the fatality should have been discovered and changed. "The rule that one cannot be charged with negligence respecting the existence of a danger, not reasonably to be anticipated in the course of events, does not imply that the exact danger was to have been expressly contemplated, but it implies that a danger, in the nature of the danger appearing, was likely to rise in connection with the conduct of his business." It appears that the company had put one of its lighting poles near Mr. Zurheide's property. To the tops of the poles was attached the span wire from which the street lamp was suspended. A guy wire was attached to the pole at the southwest corner of this street crossing and was also fastened, about four feet from the ground, to a guy post, placed to the west, between the sidewalk and the gutter. A thin wire had been stretched from this guy post, about four feet from the ground, to a tree, at about nine feet from the ground. The tree was located to the east and near the light pole at the southwest corner of the street crossing. This wire had been placed there by Mr. Zurheide, who resided on the adjoining premises, for the purpose of holding the tree upright and to prevent its branches from dropping onto a railway gate near the street. This wire was fastened to the tree by a strap and was wound around the guy post in contact with the guy wire. The street lamp, which was suspended by an interlocking device from the span wire near the center of the street crossing, had a rope attached to it which led to the light post and was used to raise and lower the lamp. When the lamp was completely raised, the only break in the metallic connection from the lamp to the span wire was an insulator of the usual type. This was placed there to prevent the electric current, which fed the lamp, from passing from the lamp to the locking device, and thence to the span wire and the other connections forming a conductor for the electric current. The complaint alleged that the Sheybogan Light, Power & Railway Company negligently constructed and maintained its plant at this street crossing; in that it placed the guy post with the guy wire attached too near the ground and in contact with the span wire near the top of the light pole, and that it negligently used a defective insulator between the lamp and the span wire, and failed to exercise due care to discover the tree wire, the broken insulator, and the consequent escape of the electric current. Wilbert was killed by accidental contact with the tree wire.

Personal.

MR. E. W. RICE, JR.—Union College, Schenectady, N. Y., has conferred upon E. W. Rice, Jr., the honorary degree of Sc.D.

MR. GEORGE WESTINGHOUSE has had the degree of doctor of engineering conferred upon him by the Institute of Technology (Technische Hochschule) of Berlin.

MR. C. J. H. WOODBURY, of the staff of the American Telephone and Telegraph Company received the degree of doctor of science from Union College at the commencement exercises on June 13.

W. A. CLEMENT, of Oswego, N. Y., has resigned his position as superintendent and manager of the Ontario Telephone Company. John Fraser, of Syracuse, N. Y., has been appointed to the position of local manager.

PROF. F. B. CROCKER, of the electrical engineering department of Columbia University, New York City, sailed last week for England. He will participate in the hospitalities extended by the Institution of Electrical Engineers of England.

MR. JEAN BART BALCOMB has severed his connection with the Ferrolite Construction Company of San Francisco to become chief engineer of the Pittsburgh Filter Manufacturing Company, with headquarters in the Farmers' Bank Building in the latter city.

MR. W. H. BALDWIN, mechanical and hydraulic engineer, has been appointed superintendent of power houses for the Ottawa Electric Company, and Mr. W. B. Morrow has been appointed chief of the operating staff of the central power plant of the company.

MR. W. W. RUBLE, of San Jose, Cal., has invented a headlight for trolley cars. It has a movable base and a rod and gear connecting with the running gear of the car or automobile, so that the beam of light follows all curves with each minutest change of direction.

MR. FRANK H. TAYLOR, until recently vice-president, and still a director, of the Westinghouse Electric & Manufacturing Company, has just gone abroad with his family, and will spend the Summer in European travel, partly in England and largely in Mediterranean waters.

SIMES-MERRITT.—Mr. Rowland J. Simes, Jr., a member of the staff of the old *Electrical Engineer* and for some years past engaged in the electrical supply industry, was married on June 14, at the Lindens, Hastings-on-the-Hudson, to Miss R. R. Merritt, daughter of Mr. and Mrs. Augustus H. Merritt.

MR. L. B. STILLWELL, the consulting electrical engineer, sailed for Europe soon after completing with Mr. B. J. Arnold his report on electrifying the Erie Railroad. Mrs. Stillwell has been in poor health for some time past, and the trip will be one purely of rest and sightseeing for both of them.

MR. H. M. HIRSCHBERG, president of the Excello Arc Lamp Co., sailed on the Celtic last week. While abroad, Mr. Hirshberg will visit the factories making the Excello lamps and carbons, arranging for prompt deliveries and the satisfactory handling of the large number of orders already being received for these goods, for next season's delivery.

MR. W. H. TAPLEY, who has made a more than national reputation as electrical engineer of the great Public Printing Office at Washington, with its hundreds of motors, thousands of lamps and unique electric heating plant, has resigned, having, it is said, received a flattering offer for a prominent electrical company in Philadelphia. He will be succeeded as chief electrician by Mr. F. L. Powers, his assistant.

MR. A. J. HAUSSEGGER, who has been engaged on electrical engineering work, especially applied to mining, in Australia, for the Ganz Company, Ltd., of Budapest, Austro-Hungary, is on his way home via the United States, and has been making a careful study of American plants and conditions from the Pacific Coast to the Atlantic seaboard. During the past week he has been visiting the power houses of New York previous to sailing for Europe.

MR. CHARLES A. SCHIEREN, JR., of the firm of Charles A. Schieren & Co., manufacturers of leather belting, 37 Ferry Street, New York, has returned from a European business trip. Almost all of Mr. Schieren's time was spent in Germany, the large European business of his firm being handled through a principal branch located at Hamburg. He reports Germany as very prosperous, and found that large orders were being received there from Russia.

MR. H. W. GOODE, president of the Portland, Ore., General Electric Company, is visiting the East, and has been in Boston to take up the recent consolidation of the electric light, power and traction properties in this part of the State with the owners, and details of one management for all the properties will be worked out. Plans are to be perfected not only for managing the big interests that are held under one ownership, but improvements will be outlined for bettering the service. Mr. Goode will be away for a month and upon his return it is expected that announcements will be made of further betterments.

MAJOR J. ORTON KERBEY, the well-known Washington correspondent, has just issued a well-illustrated and interesting book on South America, entitled "The Land of To-morrow." It is essentially a story of the search for rubber. Mr. Kerbey was formerly U. S. Consul at Para, and is thoroughly familiar with the great continent whose mighty inland waters he describes. One travels with him up the Amazon and sees many things with the eyes of a very observant traveler. The volume is one of some 400 pages, and has many halftones from photographs, and original drawings by Miss Ruth S. Clements, of Washington. The book is timely in view of the Pan-American Congress at Rio de Janeiro, which Mr. Kerbey will attend on newspaper duty.

MR. GEORGE FLETT, managing director of Dick, Kerr & Co., Ltd., of London, left New York this week for London, after a stay of a few days. This will complete a trip around the world lasting six months, during which Mr. Flett has visited Calcutta, Singapore, Hong Kong, Shanghai, Tokio and other places where the company has installed large and successful electric railway systems. On Monday, June 18, Mr. Flett was given a farewell luncheon at the Lawyers' Club, by Mr. James H. McGraw, at which there were present Messrs. F. J. Sprague, J. G. White, H. H. Vreeland, H. McL. Harding, T. C. Martin, P. G. Gossler, J. M. Wakeman, H. G. Stott, M. G. Starrett, S. M. Curwen, W. S. Burnham, J. Goodell, A. N. Connett, W. S. Doran. Some very interesting references to his trip were made by Mr. Flett, and data were discussed as to methods of traction and the results of the modern steel car in electric traction under varying conditions.

MR. R. W. SEARS, an old telegraph operator, is the head of Sears, Roebuck & Co., of Chicago, the greatest retail mail order house of the West, it is said, now being incorporated with a capital of $40,000,000. Last year the firm earned net $3,000,000. It is asserted that now its business is $5,000,000 a month. All this is done by mail and for cash in advance of shipment. Mr. Richard T. Sears, the head of the firm, began the mail order business while he was employed as a telegraph operator on the Northern Pacific. In his spare moments he sold watches and firearms to his fellow employees on the railroad. The success of the scheme prompted him to go to Chicago, where he opened a store devoted wholly to mail order business. The firm was assisted by Moses Newborg, now a Wall Street banker and broker, and it started with a capital of $150,000. In the eleven years the business has grown by leaps and bounds. It now employs 8,000 clerks and has 6,000,000 customers. There are eighteen railroads which enter its plant and 100 cars are shipped daily. Mr. Sears is not yet forty-five years of age. The enterprise built up within the last few years now comprises a small city, with its own police force, schools, hospitals, etc.

MR. JOHN MURPHY, of Ottawa, Can., has been appointed electrical engineer of the Department of Railways and Canals and of the Dominion Railways Commission. He was at one time connected with the Bell Telephone Company of Canada and for some years past has been power superintendent of the Ottawa Electric Company and the Ottawa Electric Railway Company. Mr. Murphy is a member of the American Institute of Electrical Engineers, a vice-president of the Canadian Electrical Association, an associate member of the Canadian Society of Civil Engineers, and a member of the National Electric Light Association of America. On the evening after he had severed his connection with the Ottawa Electric Company Mr. Murphy was the recipient of a beautiful gold watch and chain, suitably inscribed. The presentation took place in the board room of the Ottawa Electric Company, in the presence of representatives of every department of work in the company. The address was read by Mr. T. Ahearn, president, who referred in feeling and flattering terms to the valuable services rendered the company since its inception up to the present time, and held Mr. Murphy up as an example to the many young men present of what can be accomplished by sobriety and close attention to duty. Mr. Murphy, in replying to the flattering address, referred feelingly to the happy relations which had always existed between himself and the various heads of the company, and outlined the great development of electric lighting since he took charge of the first incandescent lighting dynamo started in Ottawa twenty years ago.

Obituary.

PROF. A. K. EATON, an inventor and scientist, died on Thursday at the home of his son, Hugh M. Eaton, in Brooklyn, N. Y. He was born eighty-four years ago in Stockbridge, Mass., and graduated as a physician from Hamilton College in 1840. He never practised medicine, but devoted himself to experimenting in chemistry and the sciences. For forty years he lived in Brooklyn. Once, for a period of two years he occupied the chair of his cousin, the late Darwin G. Eaton, in the Packer Collegiate Institute. His method of manufacturing crucible steel is still in use and he was one of the very earliest designers of telephonic apparatus, in connection with which his name became well known.

Trade Publications.

IRON FURNACES.—The Wellman-Seaver-Morgan Company, Cleveland, Ohio, has issued a neatly illustrated bulletin devoted to open-hearth and re-heating furnaces for iron and steel works.

ELECTRIC FANS.—Convincing arguments concerning the energizing influence of a cooling breeze from an electric fan in the summer time are attractively presented in fliers Nos. 4503 and 5010 of the Fort Wayne Electric Works, Fort Wayne, Ind.

ATTACHMENT PLUGS.—Bulletin No. 32 of the H. T. Paiste Co., Philadelphia, is devoted to new taplets, attachment plugs and rosettes for 250-volt and 125-volt circuits. In the design of these devices especial attention has been paid to neatness.

LARGE DIRECT-CURRENT GENERATORS.—An instructive description of the constructive details of high-class modern direct-current generators for direct connection with steam engines is contained in bulletin No. 1079 of the Fort Wayne Electric Works, Fort Wayne, Ind.

PHOSPHOR BRONZE.—Price list No. 23 of the Phosphor-Bronze Smelting Company, 2200 Washington Ave., Philadelphia, Pa., deals with "Elephant Brand" phosphor-bronze for springs, pump cylinder linings, valves, ornamental work, perforated screens, diaphragms for pressure regulators and wires for telephonic and telegraphic work.

DIRECT-CURRENT MOTORS AND GENERATORS.—The Diehl Manufacturing Company, Elizabethport, N. J., has issued bulletin No. 150, devoted to belted and engine type generators, and open, semi-enclosed and entirely enclosed motors. The generators vary in rating from 25 kw to 150 kw, while the ratings of the motors vary from 30 hp to 340 hp.

ENGINE-STOP.—In an exceptionally neat bulletin entitled "The Protection of a Monarch," the Consolidated Engine-Stop Company, 130 East Twelfth Street, New York, describes the Monarch engine-stop and speed-limit system. A large portion of the bulletin is devoted to exact reproduction of testimonials from well-known companies relating to the reliability of the above-named engine-stop.

INDICATING INSTRUMENTS.—An illustrated folder recently issued by the Wagner Electric Mfg. Company, St. Louis, Mo., gives a pictorial description of portable and switchboard voltmeters, wattmeters, ammeters, power factor and frequency indicators. It is stated that the line of instruments manufactured by this company is as complete as is manufactured by any maker, either in this country or abroad.

OIL ENGINES.—The De La Vergne Machine Company, of New York, has just issued a new 82-page catalogue describing the mode of operation of the Hornsby-Akroyd oil engine and giving illustrations and short descriptions of the more recent installations of these engines. It is stated that over 14,000 of these engines are now in operation, and that the cost of energy is only from ¼ to ½ cent per brake hp-hour.

REFLECTING ARC.—The Holophane Glass Company, 227 Fulton Street, New York, is distributing a neat desk blotter containing an illustration of the Pagoda "reflecting arc" which consists of a cluster of incandescent lamps, each being provided with a shade and the cluster as a whole being equipped with a concentrating reflector. It is claimed that these lighting equipments are ideal for the illumination of stores.

TURBO-GENERATORS.—The Allis-Chalmers Company, in preparing its bulletin No. 1504 on steam turbines and generators, has certainly added some valuable facts to the general knowledge on this popular type of prime mover. The impulse and reaction type are carefully compared as are also the preferable arrangement, whether horizontal or vertical. This is followed by a lucid description of the Parsons turbine manufactured by the company and of the generator used in connection with it.

ENGINEERING WORK.—The Westinghouse, Church, Kerr & Company, of New York, N. Y., have just published a neat 76-page booklet called "Work Done," describing some of the important installations for which they have acted as engineers. Among the work referred to may be mentioned the following: The Horgan's Falls (Ga.) power plant of the Atlanta Water & Electric Power Company; the Great Falls & Old Dominion Railroad Company; the Warren (R. I.) plant, and the Back Bay, Boston, station of the New York, New Haven & Hartford Railroad.

STORAGE BATTERIES.—The Electric Storage Battery Company, Philadelphia, Pa., has issued as bulletin No. 98 a photographic description of various equipments of "Chloride Accumulators" now in use. In connection with each equipment there is shown a station load curve which serves to illustrate the advantages of a storage battery in smoothing out the generator load, carrying the total day load, or tiding the station over emergencies. Bulletin No. 97 of the same company gives extended discussions of the "Chloride Accumulators" in railway and central lighting station service in the cities of Milwaukee and Chicago.

THE COOPER HEWITT ELECTRIC COMPANY, of New York City, has issued in large hardsome form a pamphlet descriptive and illustrative of its mercury vapor lamps. It is No. 12 in the company's series of publications and discusses its theme in a very interesting manner. The views include a variety of work and a number of letters are presented from the managers of offices, plants, docks, etc., where the lamps are in service. Some of these testimonials are very strong as to efficiency and economy. The pamphlet also devotes some space wisely to the mercury vapor converter that is now proving itself so valuable an adjunct to the alternating-current system of distribution.

THE GOULD STORAGE BATTERY CO., has just issued two new additions to its Catalogue J in the form of booklets ready for filing. Part 2 deals with the "stationary types" of batteries in glass and lead lined tanks. It shows an alteration the company has made in the conducting lug heretofore used; the new type being split, one part leading to the edge of the plate while the other reaches towards the center. This is a step forward in battery construction in that it does away with all local action and secures a more even distribution of the current. Part IV refers to "train lighting types" and shows various new styles of batteries. The new types have many commendable points among which are: The case is absolutely acid proof, having special attachments to prevent leakage; an insulating air gap is left between the cells, insuring insulation internally; porcelain rollers and spacing pieces are used on the case, insuring insulation from the car box and each other; all corrodible parts have been reduced to a minimum and the workmanship throughout is of the highest order. Both booklets contain matter and tables of great interest to those who have need of a constant and economical source of power. They may be obtained at the company's New York offices, 1 West 34th Street, or from the branch offices.

News of the Trade.

THE PARAGON INSULATING COMPANY, of Cleveland, which has recently erected a new plant at Findlay, has commenced shipping material from the new establishment. The first shipment was a carload of 40 tons of insulating material to the Pittsburgh Reduction Company, at Messina, N. Y. The company utilizes one of the waste products of the National Refining Company.

THE BECK FLAMING ARC LAMP.—A striking illustration of the remarkable illuminating powers of the flaming arc was given in the Convention hall at Atlantic City. Mr. Louis J. Aurbacher, of the Beck Flaming Lamp Co., installed one of the Beck Flaming Lamps to light up the hall. The lamp, taking only 352 watts at the arc, lights the hall very much better than the several hundred incandescent lamps regularly used. In fact, the light was so bright that Mr. Brudett, speaker of the evening, requested that it be turned out during his lecture.

THE CANADIAN WESTINGHOUSE COMPANY, of Hamilton, Ont., has shipped to the British Columbia Electric Railroad Company the largest generator ever made in Canada. The equipment consists of one 1,633-kw, three-phase, 60-cycle, 200-r.p.m., engine type, revolving field generator for direct connection to a water wheel; one rotary converter, 900 kw., 500 volts, three phase, 60 cycles, 400 r.p.m.; 8 air-blast transformers, each 479 kw, 2,200 volts to 24,300 volts, 60 cycles, also the necessary switchboards etc. R. H. Sperling is general manager of the railway.

THE REYNOLDS ELECTRIC FLASHER MFG. COMPANY, which has for the past few years been located at 221 Fifth Ave., Chicago, has moved to 191-193 Fifth Ave. This move was made necessary by the large increase in business of this concern. The quarters now occupied by this company are four times as large as those formerly occupied, and will enable it to fill all orders for its popular "Reco" and "Improved Reynolds Flashers" and "Reco Whirlers" very promptly. The Reyonlds Company has built its business by liberal treatment of the trade, fair business methods and the superior quality of the goods which it has produced.

STEAM PIPE COVERING FOR MINING PLANTS.—The H. W. Johns-Manville Co., of 100 William St., New York City, has for a number of years been meeting with remarkable success in the installation of its J-M combination felt coverings on pipes in mines and surfaces exposed to extreme weather conditions. In several instances it has demonstrated the feasibility of carrying steam considerably over a mile, having undertaken to accomplish this result even where engineers considered it an impossibility. The best results are obtained when the coverings are applied by the manufacturer, who maintains a force of thoroughly skilled mechanics for the installation of this covering in all parts of the country. All tests under actual working conditions prove the covering to be most efficient and durable, even when exposed to the most severe conditions. The H. W. Johns-Manville Co. will be glad to give full information regarding this product to anyone interested.

STANLEY-G. I.—At the recent exhibition by the National Electric Light Association at Atlantic City, the Stanley-G. I. Electric Mfg. Company, of Pittsfield, Mass., had a "live" exhibit of lighting supplies connected to a panel, equipped with instruments, Wright demand indicators, switches and circuit breakers, and seven forms of "G. I." enclosed arc lamps were exhibited, the 110-volt and series-multiple power circuit lamps being shown burning. A 3¼-ampere, 110-volt, direct-current multiple "Short" arc lamp (only 15½ inches high) attracted much attention. The exhibit also comprised a "G. I." direct-current motor-generator set and "S.K.C." induction motors and lighting transformers; a line of lightning arresters, hanger boards for arc lamps, several forms of floor and wall outlet boxes, flush push-button switches, pendant switches, knife-switches and punched-clip switches. The Stanley-G. I. Company were represented at the convention by Messrs. M. D. Barr, J. H. Nable, J. E. Cutler, A. W. Henshaw, H. C. Rice, A. H. Abell, G. H. Noble, Almon Foster, E. B. Dodd and J. S. Codman.

CROCKER-WHEELER COMPANY, Ampere, N. J., reports among recent sales, the following: One 425-kw and one 225-kw generator, two 100-hp, one 50-hp, and one 25-hp motor to the Lehigh Portland Cement Company, Ormrod, Pa.; two 75-kw, 2,300-volt alternators to the Southern Railway Company, Atlanta, Ga.; one 75-hp motor to the American Printing Company, Fall River, Mass.; one 60-kw, 230-volt, direct-current generator and motors of 5, 7½, 12 and 15-hp to the M. S. Brown Electric Company, Columbus, O.; one 50-kw generator to the Lion Brewery, Newark, N. J.; three 75-kw, 250-volt generators to J. MacWilliams & Company, Memphis, Tenn; two 75-kw, 240-volt generators to the American Fork & Hoe Company, Ashtabula, O.; one 150-kw generator to Maher & Flockhart, Newark, N. J.; one 75-kw alternating-current generator and one 4½-hp motor to the World Star Knitting Company, Pay City, Mich.; one 100-kw generator and motors of 20, 25 and 35-hp to the Floyd Wells Company, Royersford, Pa.; and three 1-hp motors to Wellman-Seaver-Morgan Company, Cleveland, Ohio.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 12, 1906.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

822,936. WIRELESS TELEGRAPH SYSTEM; Lee DeForest, New York, N. Y. App. filed Feb. 2, 1906. Designed to provide a wireless telegraph system whose natural mode of operation is monoperiodic and has an antenna system, and a closed oscillating circuit connected thereto, and so constructed and arranged that the two paths from the top of the antenna to earth are equal in natural period.

822,940. APPARATUS FOR RECOVERING PRECIOUS METALS; Edward J. Garvin, Portland, Ore. App. filed Jan. 15, 1906. An apparatus for recovering precious metals from ore solutions and ores, and consists more particularly in the details of an improved precipitating tank for the solution and ore.

822,951. RAILWAY SIGNAL; John S. Jeffrey, Columbus, O. App. filed Nov. 15, 1905. Mechanical details of an electric signaling device, by which persons may flag a train at local stations without standing on the track. The device is arranged to be automatically replaced by the passage of a train.

822,961. TROLLEY PLACER AND GUIDE; Edgar A. Leake, Lawrence, Mass. App. filed Oct. 18, 1905. Pivoted in the trolley harp and adjacent to the usual wheel, are a pair of eccentric bearers or shoes, which automatically turn when the wire leaves the wheel, so as to replace the same thereon.

822,965. CALLING DEVICE FOR TELEPHONE-EXCHANGES; Frank A. Lundquist, Chicago, Ill. App. filed July 11, 1904.

822,966. CALLING DEVICE FOR TELEPHONE-EXCHANGES; Frank A. Lundquist, Chicago, Ill. App. filed Feb. 6, 1905.

822,968. RELAY; Ry H. Manson, Elyria, O. App. filed May 25, 1904. A telephone relay having a magnet with a bell crank lever forming an armature and arranged to move platinum tipped contact springs to close the relay circuits.

822,973. AUTOMATIC TELEPHONE SYSTEM; August A. Monson, Grey Eagle, Minn. App. filed Jan. 24, 1905.

822,987. ELECTRICAL MEASURING INSTRUMENT; Frank W. Roller, Plainfield, N. J. App. filed July 18, 1904.

823,019. LIQUID FILTER AND PURIFIER; Milton F. Adams, New York, N. Y. App. filed June 10, 1905. A water filter device having layers of conducting material through which the water flows and current passes, and where the current deposits the particles in the water so as to purify the same.

823,040. AUTOMATIC SAFETY TROLLEY POLE; John R. French, Los Angeles, Cal. App. filed Mar. 3, 1905. The trolley pole has a hinged section on its upper end which carries the wheel and which trips the tension spring of the pole so as to drop the latter when the wheel leaves the wire.

823,044. MULTIPLE FUSE PLUG; Alexander Hepke and Kurt Diener, Berlin, Germany. App. filed Feb. 16, 1905. Provides stationary fuse wires within the plug body and a current taking-up contact body movable in relation to the plug body and the fuse wires respectively.

823,055. TRANSMISSION AND DISTRIBUTION OF ELECTRIC POWER; Jacob Kruyswijk, Ryswijk, near the Hague, Netherlands. App. filed Aug. 3, 1904.

823,061. TELEPHONE-RECEIVER; Charles T. Mason, Sumter, S. C. App. filed Mar. 17, 1905.

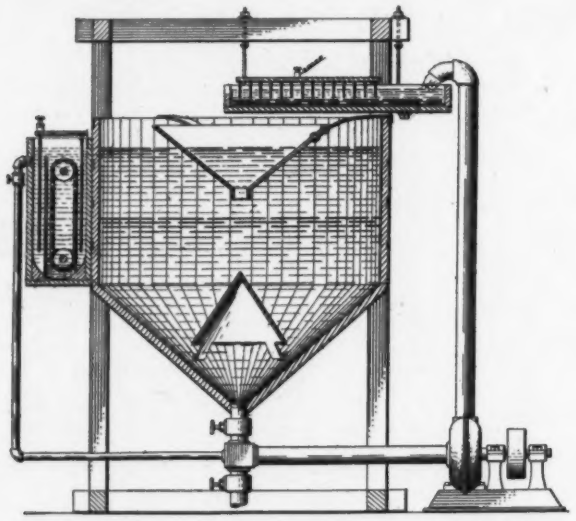
823,067. ELECTRIC RAILWAY SYSTEM; John L. Moore, New York, N. Y. App. filed Nov. 16, 1904. A railroad having a sectional trolley conductor, the divisions of which are successively energized during the passage of the car.

823,073. ELECTRIC SWITCH; William J. O'Leary and William Coonan, Montreal, Canada. App. filed Aug. 4, 1904. An electric switch comprising a bed plate and a gravity actuated frame pivotally mounted thereon, a pivotally supported locking member, and locking means carried by said bed plate in position to engage the respective ends of such pivoted locking member.

823,086. ALTERNATING CURRENT TRANSLATING DEVICE; Louis H. Thullen, Edgewood, Pa. App. filed Oct. 13, 1903. An alternating current relay having a movable member operated in one direction by electro-magnetic means when affected by an alternating current, and having a crank shaft and contact points located near the center of rotation of said shaft.

823,090. TELEPHONE-TRANSMITTER ATTACHMENT; Robert A. Walton, Los Angeles, Cal. App. filed July 25, 1905.

823,091. TELEPHONE SWITCHING APPARATUS; Robert A. Walton, Los Angeles, Cal. App. filed July 25, 1905.



822,940.—Apparatus for Recovering Precious Metals.

823,092. TELEPHONE-TRANSMITTER ATTACHMENT; Robert A. Walton, Los Angeles, Cal. App. filed July 25, 1905.

823,118. ELECTRICALLY DRIVEN PUMP; Howard F. Gurney, Jersey City, N. J. App. filed June 20, 1904. An automatically operated motor circuit switch, and a pump having a variable working stroke, and means for throwing the heat of the pump on to the motor when the motor has approximated a predetermined speed.

823,164. ELECTRIC INDICATOR; Grover S. Eble, New York, N. Y. App. filed Aug. 7, 1905. Details of an electrically operated device for indicating the position of a ship's rudder or a follower device of any sort, for instance, the signaling mechanism on a ship. Has a special arrangement of signal lamps.

823,176. ELECTRIC TELEGRAPHY; Isidor Kitsee, Philadelphia, Pa. App. filed Dec. 15, 1905. A code for telegraphic signals designed to have alternating-current pulsations.

823,183. SWITCHBOARD; William C. Marchant, Chicago, Ill. App. filed Aug. 7, 1905. Details of a connection for a knife blade switch. The base plate of the switch has a projecting boss which is drilled to receive the wire.

823,196. SYSTEM OF TRAIN CONTROL; August Sundh, Yonkers, N. Y. App. filed Mar. 16, 1905. Complete diagram of circuits for a multiple unit control system of an electric train.

823,206. TELEGRAPH TRANSMITTER; Albert C. Crehore, Tarrytown, N. Y., and George O. Squier, Washington, D. C. App. filed Apr. 8, 1901. The telegraph transmitter is designed to transmit waves having a sine curve rather than the sharply cut waves which are ordinarily transmitted by automatic devices.

823,215. TELEPHONE SYSTEM; Calvin R. Green and David R. Green, Rising Sun, Ind. App. filed Aug. 24, 1905.

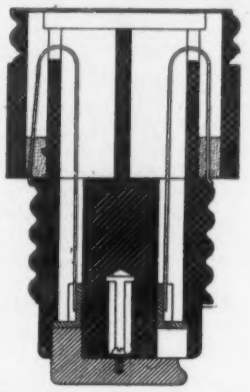
823,220. CIRCUIT CONNECTION FOR, AND METHOD OF, OPERATING ALTERNATING MOTORS; Dugald C. Jackson, Madison, Wis. App. filed May 16, 1904.

823,234. MAGNETIC ORE SEPARATOR; Henry H. Wait, Chicago, Ill. App. filed Mar. 20, 1905. An iron frame is wound to present a magnetic pole which inductively energizes a rotating cylinder diagonally disposed above a reciprocating body.

823,235. MAGNETIC SEPARATOR; Henry H. Wait, Chicago, Ill. App. filed Mar. 20, 1905. The ore particles are fed from a hopper so as to drop through a narrow space between pole faces which deflect the magnetic particles to one side so that they are collected in a separate receptacle.

823,265. FRAME FOR WINDING ARMATURE COILS; Louis R. R. De Planque and James Biggerstaff, Yonkers, N. Y. App. filed Sept. 14, 1905. Comprises a member having a portion provided with a plurality of steps and a shoulder portion and ears arranged on each of said steps. Has a detachable member adapted to act as a shoulder portion when assembled with the first member.

823,292. RAIL BOND; Edwin W. Robinson, Punxsutawney, Pa. App. filed July 12, 1905. A railway bond having threaded ends projecting through the rail which are received in conical plugs and which may be tightened into engagement with the rails.



823,044.—Multiple Fuse Plug.

823,295. DEVICE FOR CONTROLLING ELECTRICAL CIRCUITS; Edmund O. Schweitzer, Chicago, Ill. App. filed Mar. 26, 1904. A circuit breaker having connection through a fluid therein which expands to break the circuit when heated.

823,301. MAGNETIC SEPARATOR; Frederick T. Snyder, Kansas City, Mo. App. filed Sept. 2, 1902. Details of construction of a separator having an inclined shoot over which the ore is fed, and electromagnets below the shoot, disposed to present an edge of the polefaces diagonally across the bottom of the shoot.

823,302. MAGNETIC SEPARATOR; Frederick T. Snyder, Oak Park, Ill. App. filed Nov. 28, 1902. Relates to another form of construction having a rotary drum with a corrugated or serrated surface.

823,303. MAGNETIC SEPARATOR; Frederick T. Snyder, Oak Park, Ill. App. filed Dec. 1, 1902. A still further modification having certain features of construction slightly changed.

823,304. MAGNETIC SEPARATOR; Frederick T. Snyder, Oak Park, Ill. App. filed Dec. 6, 1902. A form of separator having a central drum and an electromagnet with two pole faces of different areas presented thereto.

823,332. TROLLEY FINDER; William J. Hinton, Danville, Ill. App. filed Aug. 16, 1905. A guide for replacing the wheel upon the wire. The guide has a lever attachment with the trolley cord, whereby it is only raised to operative position when the cord is taut.

823,336. TRANSMITTER-ARM; Herbert L. Knight, Cleveland, O. App. filed July 28, 1905.

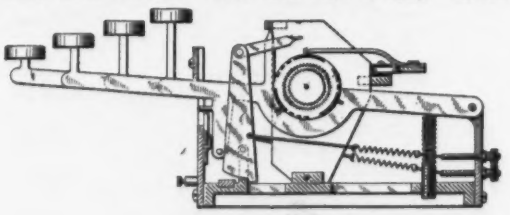
823,402. STATIC VALVE FOR WIRELESS TELEGRAPH SYSTEMS; Lee De Forest, New York, N. Y. App. filed Dec. 9, 1905. Designed to prevent static disturbances of the wireless system by atmospheric electricity. Has an oscillating detector and an electrolytic static valve.

823,435. PROCESS OF TREATING ORGANIC SUBSTANCES IN PRESENCE OF VANADIUM COMPOUNDS; Erich Oppermann, Hochst-on-the-Main, Germany. App. filed Aug. 31, 1904.

823,438. TROLLEY HANGER; Thomas Price, Minneapolis, Minn. App. filed June 5, 1905. The hanger has depending ears to engage the trolley wire and which may be clamped there against by a hollow sleeve and pressed downward thereon.

823,461. INSULATOR PIN; James H. Bullard, Springfield, Mass. App. filed Mar. 29, 1905. The insulator has a metallic bushing therein which is formed to receive a number of steel wires which project from the insulator and form a skeleton support therefor.

823,478. SAFETY SYSTEM FOR MOTOR PROPELLED CARS; John A. Miller, Baltimore, Md. App. filed Nov. 6, 1905. Circuit breakers



823,206.—Telegraph Transmitter.

are organized under the car so as to prevent the completion of the motor circuits until the doors are closed.

823,484. ELECTRIC CONDUCTOR UNION; Frederick W. Sorg, Englewood, N. J. App. filed Feb. 21, 1905. A sleeve having a section like the figure 3 which encloses the two wires to be joined and is thereupon twisted so as to hold them properly together.

823,492. MAGNETIC SEPARATOR; Lewis A. Dunham, Kansas City, Mo. App. filed Dec. 8, 1902. A drum has iron sections mechanically separated from one another and energized inductively by passing over a centrally contained electromagnet.

823,494. GUARD FOR MOUTHPIECES OF TELEPHONE-TRANSMITTERS; Gerhardt E. Grimm, Philadelphia, Pa. App. filed May 18, 1906.

823,495. ALTERNATING-CURRENT MOTOR; John O. Heinze, Jr., Lowell, Mass. App. filed May 29, 1905.